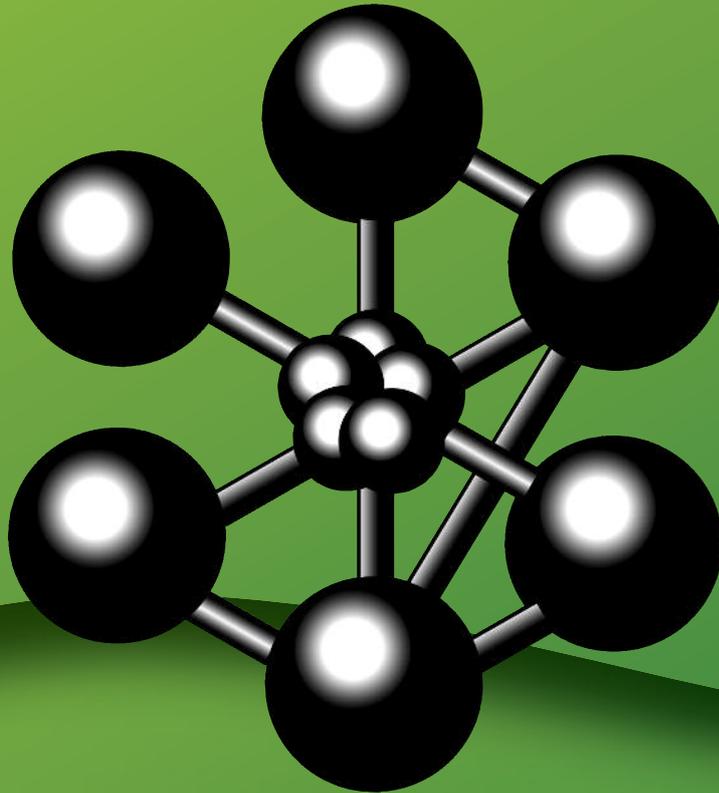


Cast3M



www-cast3m.cea.fr

Finite Element tool box
for Structural and Fluid Mechanics



Cast3M is a finite element tool box for structural and fluid mechanics.

Cast3M is a fully integrated software including a powerful solver, pre-processing (data specification, model building) and post-processing (visualization, results extractions) facilities.

The development of Cast3M is carried out in the frame of a mechanical research activity. It is aimed at building a powerful, flexible tool that can be used to design, dimension and analyze structures and components for nuclear energy industry as well as for other traditional industrial areas.

Cast3M simulates numerous physical phenomena

► Static and quasi-static mechanics

► Contact, friction

► Buckling

► Dynamics

Temporal or modal analysis
Fluid-structure interaction
Rotating machines

► Fracture mechanics

Enriched finite elements (X-FEM)
Quasi-static and dynamic propagation
Local approach (SIF) and energy based approach (J integral)
Cohesive zone models

► Thermo-mechanical analysis

Steady and transient state
Conduction, convection, radiation (exchange with media, surface to surface, shape factor ...)
Phase transition
Temperature dependant materials
Thermal loading

► Fluid mechanics

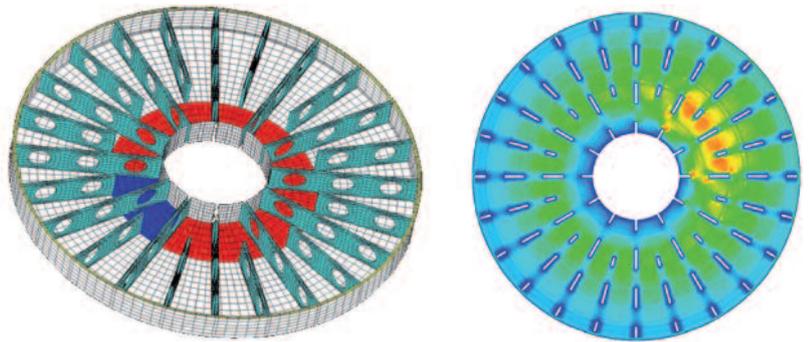
Compressible/incompressible, laminar/turbulent
Darcy equation (saturated porous media), steady/transient
Particular methods
Navier-Stokes equations, steady/transient

► Magnetostatics

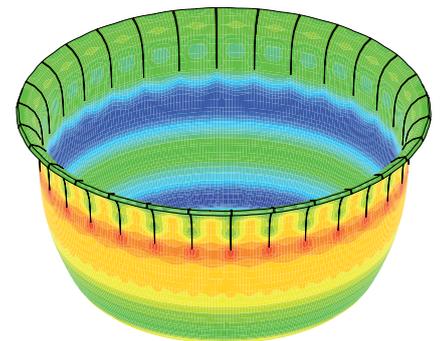
Scalar/vector potential
Biot-Savart magnetic fields computation
Surface eddy currents

► Multi species diffusion (Fick's law)

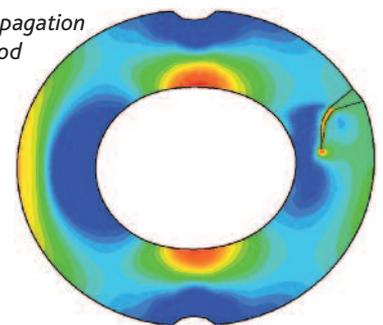
► Thermo-hydro-mechanical coupling



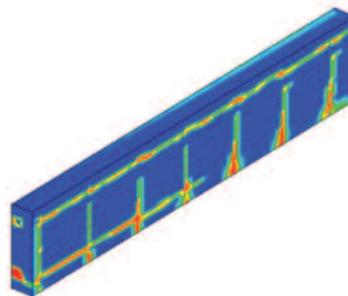
Flow velocity in the lower plenum of a gas-cooled reactor



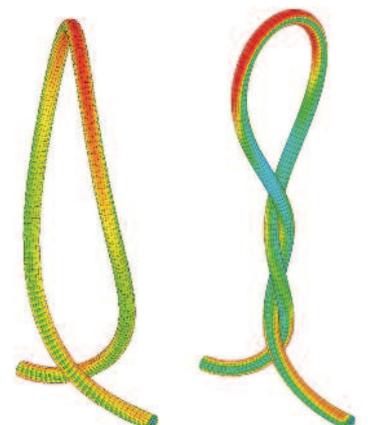
Stress corrosion cracking in a bucket



Dynamical crack propagation with the XFEM method



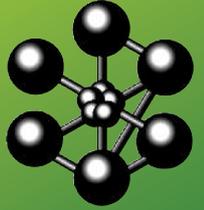
Corrosion of the metal reinforcement in a concrete beam



Elastic buckling of a rope by torsion

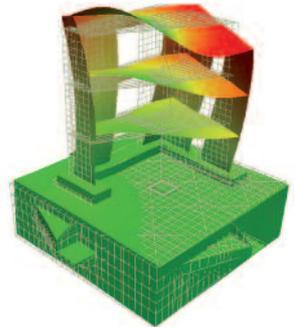
Cast3M allows to model numerous physical phenomena: mechanical problems in statics and dynamics (time and modal analysis), linear or non linear (material behavior, geometry ...), structure failure (damage, fracture), steady and transient state thermal analysis (conduction, convection, radiation ...), fluid mechanics, fluid-structure interaction, etc.

Users can easily develop specific functions, thanks to the object-oriented Cast3M design based on elementary operators.



Cast3M offers an extensive library of material models

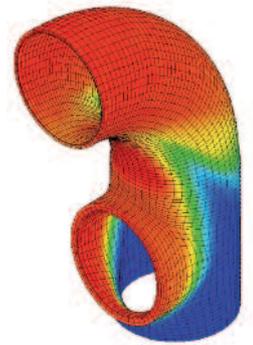
- ▶ **Linear and non linear elasticity, isotropic and anisotropic**
- ▶ **Plasticity** (von Mises, Drucker-Prager, Chaboche, Camclay ...)
- ▶ **Visco-plasticity, creep** (Norton, Maxwell, Chaboche...)
- ▶ **Damage** (Mazars, Gurson, Rousselier, Chaboche-Lemaitre...).
- ▶ **Variable material properties** (time, temperature, irradiation ...)
- ▶ **Users can also develop subroutine (UMAT) to define a specific mechanical behavior**



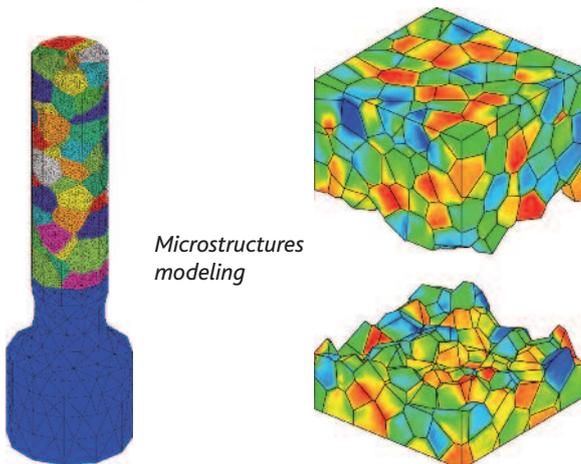
Deformed shape of a building scale model under seismic loads

Cast3M covers a vast spectrum of applications

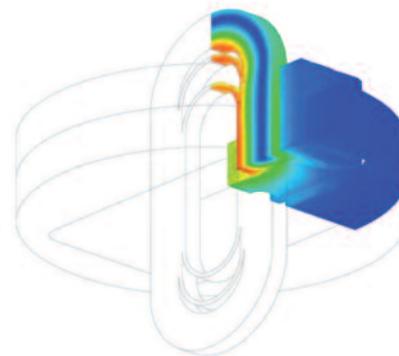
- ▶ **Mechanical components and assemblies** (dimensioning, failure ...)
- ▶ **Civil Engineering** (concrete, reinforcement, prestress tendons...)
- ▶ **Soil mechanics** (geologic disposal, transport through geological media)
- ▶ **Earthquakes** (seismic loads, soil-structure interaction, building integrity, ...)
- ▶ **Material science** (microstructures modeling, behavior laws development, ...) including nuclear fuels



Temperature distribution in a pipe mixing tee and elbow



Microstructures modeling



Magnetic field intensity in a superconductor



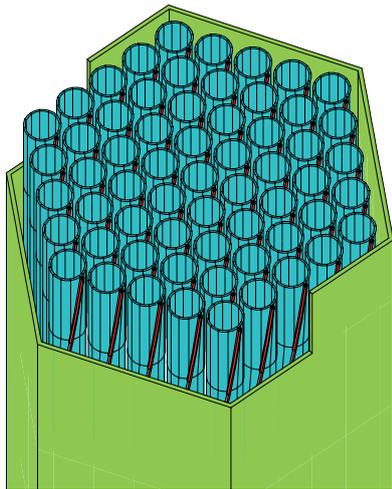
Cracking in a pre-stressed concrete containment vessel

Cast3M

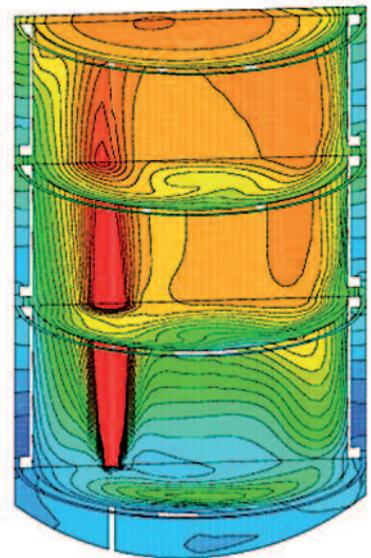
Cast3M is a development platform

- ▶ Cast3M has its own programming language: Gibiane, which can be used in an interactive or scripting mode
- ▶ Gibiane is an easy to use, object oriented and high level programming language (conditional expressions, loops, recursion, subroutines...)
- ▶ Users can develop their own functions and programs

Industrial application : Cast3M is the development platform of several specialized numerical tools which are used as a valid support for the design, dimensioning and certification of nuclear installations (pressurized water reactors, generation IV reactor...) and in other industries



*Specialized numerical tool
for fuel bundles*



*Specialized numerical tool for
nitrogen risk analysis in a
containment vessel*

Cast3M can exchange data with other software

- ▶ AVS format (read, write)
- ▶ MED format for Salomé (read, write)
- ▶ VTK format for Paraview (write)
- ▶ INP format for Abaqus (write)
- ▶ UNV format for Gmsh (read)
- ▶ FEM format for Hypermesh (read)
- ▶ ASCII text files (read, write)
- ▶ External command call
- ▶ Access to environment variables
- ▶ Sockets communication (in server or client mode)

Cast3M is available

- ▶ With an Education and Research license (free and open source)
- ▶ With an Industrial license (including technical support and maintenance)
- ▶ On various operating systems: GNU/Linux, Windows, Mac OS and any other on demand



Annual release in April
Annual user's seminar in November



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