Software Development

**METAFOR**: an object-oriented Finite Element code for the simulation of solids submitted to large deformations
- 2D/3D elements (large strains).
- Implicit/explicit time integration (HHT, Chung Hulbert, ...)
- Thermomechanical coupling (staggered or fully coupled schemes).
- Frictional contact between deformable bodies or analytical surfaces.
- Arbitrary Lagrangian Eulerian formalism.
- Meshing and remeshing procedures.
- Large set of constitutive laws (thermo-elasto-viscoplastic, damage, ...)
- Crack propagation (erosion method).

**Other Simulation Codes**
- **METALUB**: lubricated rollgap model for the simulation of cold rolling.
- **PFEM**: 2D incompressible fluid solver by the Particle Finite Element method.
- **CUPyDO**: coupling interface of fluid and solid solvers.
- **Waves**: basic C++/python framework for the rapid development of simulation codes.

Crash, Impact & Fracture Simulations

**Blade Impact on the Casing of an Aeroengine**
- Study of the behaviour of titanium alloys at very high strain rates.
- Composite casings.
- Fan Blade Out simulations.
- Simulation of abradable materials.

**Honeycomb Crushing**
- Study of an energy absorption element for leading edge slat or fixed leading edge through numerical simulations.

Metal Forming Simulations

**Springback Prediction in Roll Forming**
- Development of a fast 3D model of industrial forming mills.

**Cooling and Straightening of Sheet Piles**
- Prediction of the final product shape and the residual stresses.

Biomechanics

**Brain Model**
- Unstructured FE mesh generation from medical images (MRI scans).
- Simulation of neurosurgery and injuries.

**Bone Fracture Simulation**
- Prediction of human and animal bone fractures (in collaboration with CHU Liège and the faculty of Veterinary Medicine of ULiège).

Additive Manufacturing

**Laser Solid Forming of Ti-6Al-4V Metal Powder**
- Activation/Deactivation of finite elements and boundary conditions based on the current laser position.

**Snapping Mechanical Metamaterials under Tension**
- Dynamic simulation of metamaterials with tunable stiffness manufactured by additive processes.

Fluid Structure Interaction Problems

**Vortex-Induced Vibrations (VIV) of a Cantilever**
- **CUPyDO**: coupling of specialized solvers (Metafor/SU2) using a python interface.
- Collaboration with the MTFE group of Prof. V. Terrapon.

**Filling of an elastic container**
- Strong fluid/solid coupling involving large deformations of the elastic container and solved by CUPyDO.
- Fluid discretized by the PFEM.
- Solid solved by Metafor.

**Other Simulation Codes**
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University of Liège, Dept. of Aerospace and Mechanical Engineering, Liège, Belgium.
jp.ponthot@uliege.be, r.boman@uliege.be