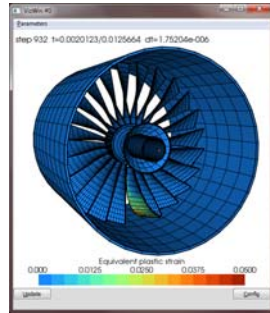


## Software Development

### 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).



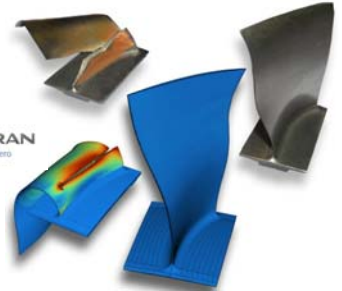
### Other Simulation Codes

- **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

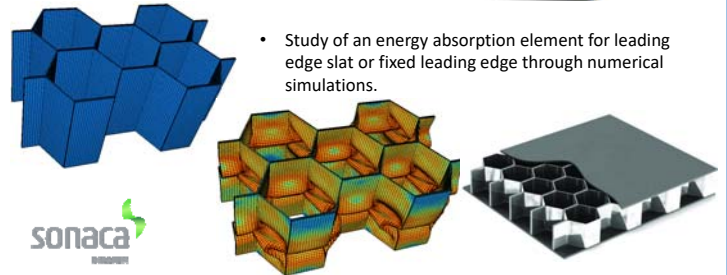
### Blade Impact on the Casing of an Aeroengine

- Study of the behaviour of titanium alloys at very high strain rates.
- Composite casings.
- Fan Blade Out simulations.
- Simulation of abradable materials.



### Honeycomb Crushing

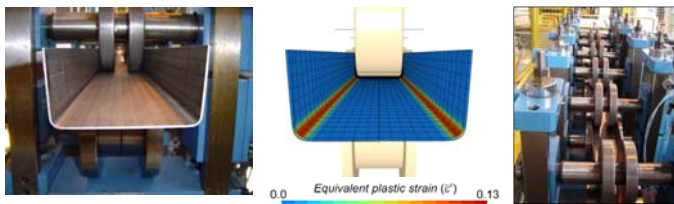
- Study of an energy absorption element for leading edge slat or fixed leading edge through numerical simulations.



## Metal Forming Simulations

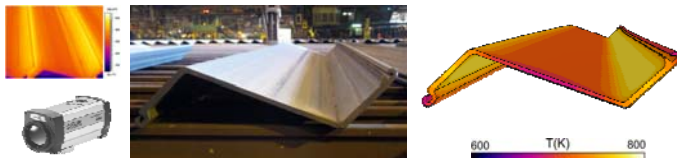
### Springback Prediction in Roll Forming

- Development of a fast 3D model of industrial forming mills.



### Cooling and Straightening of Sheet Piles

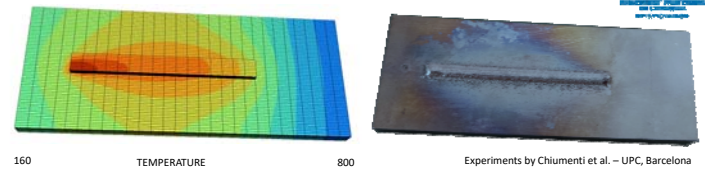
- Prediction of the final product shape and the residual stresses.



## Additive Manufacturing

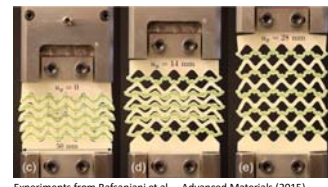
### Laser Solid Forming of Ti-6Al-4V Metal Powder

- 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.

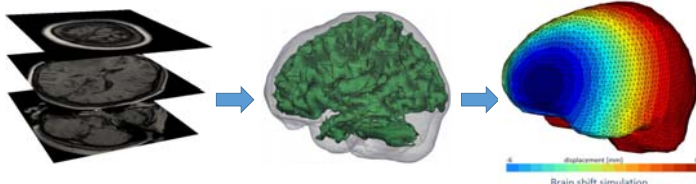


Experiments from Rafsanjani et al. - Advanced Materials (2015)

## Biomechanics

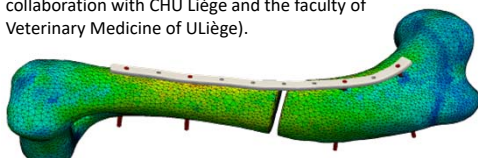
### Brain Model

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



### Bone Fracture Simulation

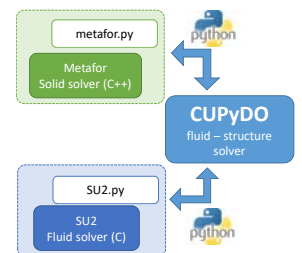
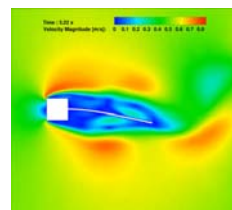
- Prediction of human and animal bone fractures (in collaboration with CHU Liège and the faculty of Veterinary Medicine of ULiège).



## 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 MTFC 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.

