Computational Solid Mechanics

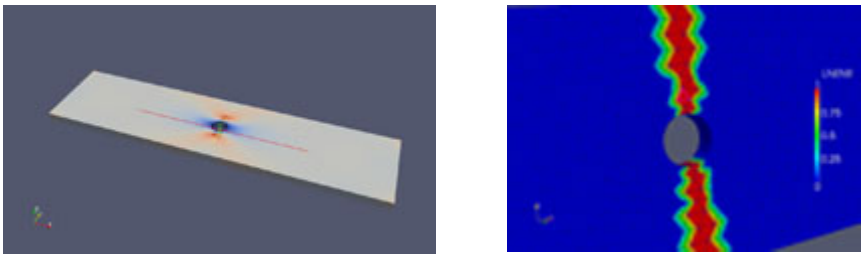
Overview:

Alya code was initially designed for Compuational Fluid Dynamics simulations. However, the actual necessities of the solid mechanics industries require the simulation of complex structures and large deformations that requiere high computational resources, such as the wind turbine industry or aeroelasticity studies.

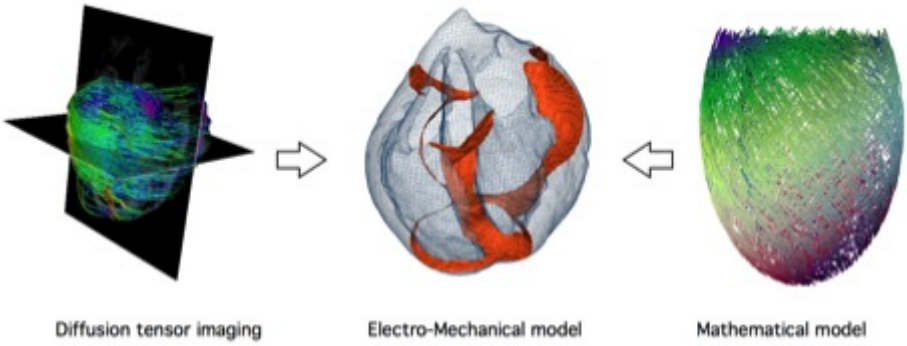
Computational Solid Mechanics research lines are mainly on the use of HPC techniques in non-linear great deformations solid mechanics, including:

- Material models for biomechanics.
- XFEM methods in fracture mechanics.
- Domain decomposition techniques.

?These lines are developed in collaboration with A. Jerusalem from IMDEA Materials (Spain).



Tensile Bar test: shell with a hole under traction force. Detail of the stress and the crack propagation



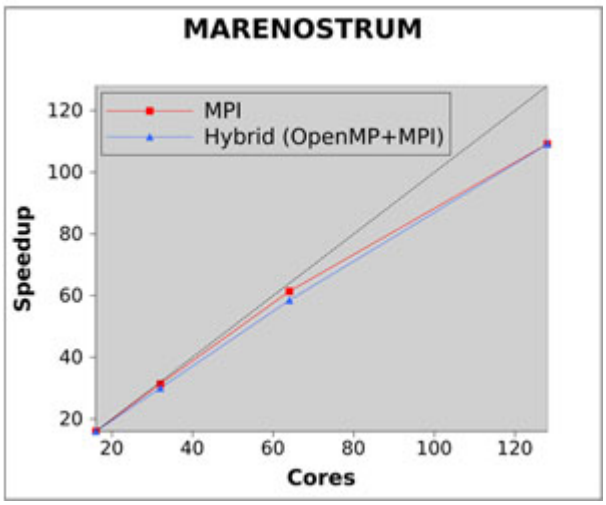
Electro-mechanical model of the heart using medical images and mathematical models for the

electric and mechanical coupling.

Objectives:

The objective is twofold: on the one hand to develop numerical techniques to meet the requirements of industry, such as fracture process, fatigue study or contact problems. On the other hand, to adapt modern architectures that combine distributed memory nodes and shared memory cores on these nodes.

An hybrid code of OpenMP and MPI parallelization is developed in order to take advantage of all the levels of parallelism that a multicore architecture offers and also to enable one MPI task accesing all the memory of a node.



Scalability of pure MPI execution vs hybrid execution in Alya-solidz

Research Lines:
Some of the lines that involve the Alya-solidz module are:

- Fluid-structure interacction
- Fracture mechanics
- Contact problems

Projects/Areas:

- PRACE 2nd implementation phase (2IP)
- PRACE 3rd implementation phase (3IP)
- Cardiac computational modelling

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