High Performance Computational Mechanics

Developing a parallel simulation code for complex physical systems capable of running efficiently in supercomputers requires wide-ranging background expertise, known as High Performance Computational Mechanics. We work on topics such as: physical and mathematical modelling, numerical methods, implementation issues, optimal design and parallel programming. Our group's main task is to link this knowledge to a broad range of application fields.

Objectives

Each application field requires specific solutions on every aspect: pre-process and input data management, simulation strategies, output analysis and validation. For each of the fields to which we contribute, we identify these particular aspects and carry out research on them in order to develop efficient and accurate sector-targeted simulations. Our main objective is to put tailored HPC-based simulations to solve complex multi-physics problems into the hands of applied science. The sectors in which we are most active are:

- Biomedical research: continuum biomechanics at organ level, specially for cardiovascular and respiratory systems
- Aerospace: external aerodynamics (compressible and incompressible flows) and aircraft engines (combustion)
- Environment: mesoscale atmospheric flows
- Automotive: external aerodynamics
- Some of the basic Computational Mechanics research lines we follow are:
- Compressible and incompressible flows

- Non-linear discrete strain solid mechanics
- Fluid-structure interaction and contact
- Electrophysiology and excitable media
- Combustion
- Mesh generation
- Optimal design

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