# Cardiovascular system simulations

Considered as a physical system, the heart is the most sophisticated pump, the outcome of a million years of evolution. Thanks to the multi-physics capabilities of the Alya code, we simulate the fluid-electro-mechanical coupling of a beating heart and the arterial blood flow.

## Summary

At the organ-level, the cardiac computational model requires the solution of the three tightly coupled fields: fluid mechanics (blood), excitable media (electrophysiology or activation potential propagation) and mechanical action (tissue, mainly cardiac muscle, tendons, wall arteries, valves, etc.). In a unique way and efficiently exploiting supercomputers and parallel programming , the three problems are simulated in a coupled fashin in BSC's in-house multi-physics and multi-scale code, Alya. The cardiac geometries are produced from several sources of medical data and images, to include as many features as possible, including anatomical data such as muscular fiber structures. In order to set up the simulation scenario, meshes are generated using an ad-hoc meshing tool, BSC's in-house IRIS Mesh. The development team includes medicine doctors, physiologists, bio-engineers, mathematicians, physicians, programers and designers. The Alya Cardiac Computational Model (Alya CCM) run on thousands of MareNostrum cores on a regular basis.

Alya CCM is a key part in the H2020 European Center of Excellence in Computational Biomedicine (CompBioMed).

## Objectives

There final objective of this reasearch line is to create a unique simulation tool which becomes the world reference as a cardiac computtional workbench.

We target to biomedical researchers coming from different areas of the Healthcare world:

- Academia and government institutes and hospitals
- Pharmaceutical industry
- Medical devices industry

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