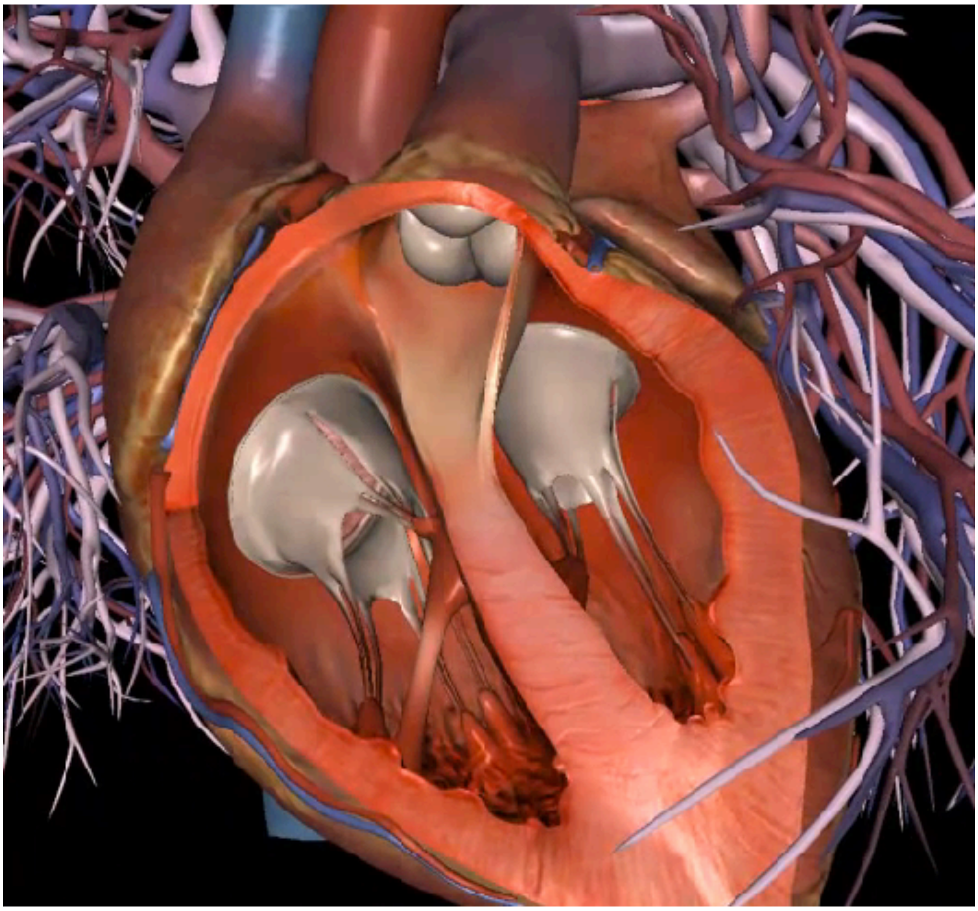
PROGETTO DI RICERCA

Left ventricular motion in clinical studies and theoretical modeling: assessment of new indicators of cardiac function

SAPIENZA - UNIVERSITÀ DI ROMA

November 22, 2013

Medical imaging and computational tools: how modelling and simulations support the clinics



11:00 - 11:45 Eduardo Soudah (CIMNE, Barcellona)

12:00 - 12:45 Stefano Gabriele (Università Roma Tre)

DISG Library at Geotechnical Hall

Via Eudossiana 18 (3rd floor) 00184 Roma

INFO: paola.nardinocchi@uniroma1.it

EDUARDO SOUDAH
International Center for Numerical Analysis in Engineering (CIMNE),
Barcelona, Spain.

Computational Fluid Dynamics (CFD) has for some time been successfully applied in the engineering field. Today, this technology is also applied in biomedical research to develop new medical tools. Based on the numerical results, new protocols and diagnoses have being employed for the patient-specific treatment. But, how is this numerical data generated? Is it reliable enough? To what extent can numerical simulations assist the classical medical protocol?

In this presentation, a computational workflow adopted in the medical field is described, starting from medical images through numerical procedures towards solutions for different cardiovascular pathologies. It includes the issues of medical image segmentation, the coupling of vascular wall mechanics, the determination of appropriate boundary conditions, and the understanding of the numerical results as shear stress maps. We will also present an introduction to a 4D flow MRI and illustrate its potential for the assessment and understanding of blood flow for various cardiovascular diseases.

STEFANO GABRIELE
Modeling and Simulation Lab (LaMS), Università Roma Tre,
Roma, Italy.

In structural mechanics, the stresses and strains within a body are limited above and below by their principal counterparts; this allows for the discussion and verification of the mechanical state of that body. Moreover, the principal stress and strain lines (which are the same only when special symmetry conditions are verified) determine the directions where the largest strains and/or stresses are to be expected. Due to these characteristics, the mechanics of fibre-reinforced bodies are often based on the detection of the principal strain lines (PSL) and, wherever needed, fibre architecture is conceived in order to make the fibre lines coincide with the PSL.

In this talk, the ability to obtain information on the fibre architecture within the heart walls, thanks to the detection of the PSL, is discussed. Now that full-volume images of the heart walls can be obtained by high-resolution 3D speckle tracking-based motion-detecting echocardiography (STE), myocardium strains may be investigated non-invasively with high accuracy . Precisely, the patterns of the PSL on the endocardial and epicardial surfaces of the left ventricles (LVs) of a few normal adults are analysed and discussed. The primary and secondary strain lines, corresponding to the smallest and the largest PSL, are evaluated as the outcomes of an eigenvalue analysis on a strain tensor, based on echocardiographic data.