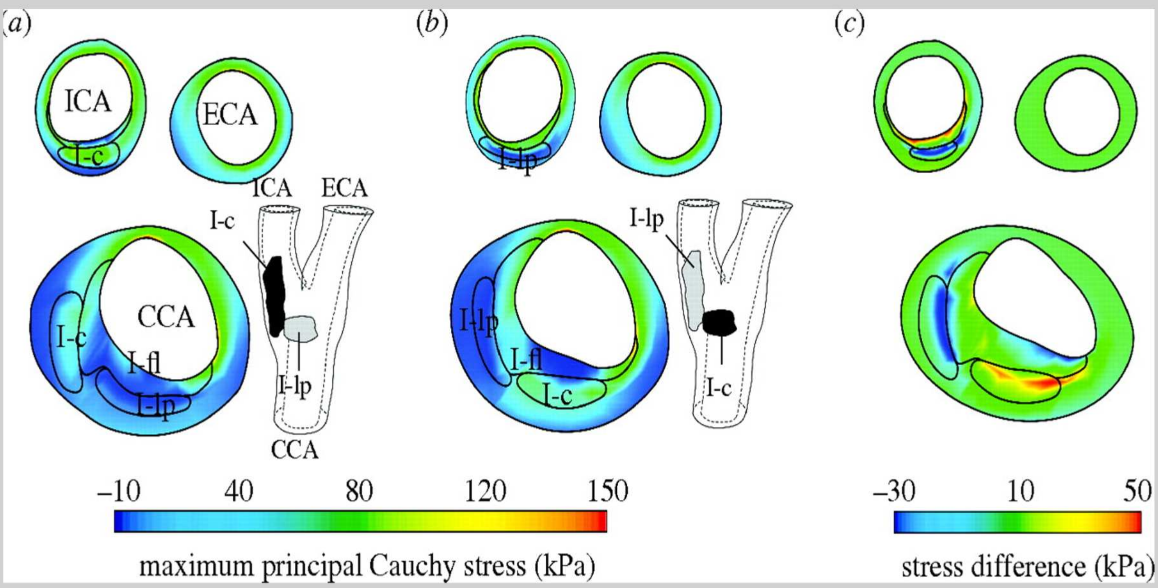
SEMINARIO INTERUNIVERSITARIO DE MECÁNICA Y MATERIALES

SEMINARIO JOSÉ ANTONIO GARCÍA GARCÍA

MÁSTER DE ESTRUCTURAS

seminario interuniversitario de mecánica y materiales

STRUCTURAL MODELING OF BIOSOLIDS UNDER FINITE STRAINS: FROM MICRO TO MACRO SCALES



Prof. Gerhard A. HOLZAPFEL

Graz University of Technology, Austria
Royal Institute of Technology, Sweden

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In this talk we illustrate the importance of considering the detailed structure of a biosolid in a material model. We focus on the micro-structure of arterial walls in health and disease, of the myocardium and of densely cross-linked actin networks which exist mainly in the cortical region of the cell. It is shown how the material structure can be quantified by polarized light microscopy or second-harmonic generation which is a nonlinear optical process with very high axial and lateral resolutions to identify, e.g., the collagen structure of the material. Important is the quantification of the structure for the use in material models since otherwise the stresses predicted by using numerical tools might not reflect the ‘true’ in vivo conditions.

Note that changes in the structural components play an important role in the pathogenesis of the tissue degeneration, e.g., in aneurysmal development. We particularly show how such experimental information can be used within constitutive models. To demonstrate the efficacy of structural models we analyze a sample of collagenous myocardial tissue and focus on the significant changes of the mechanical response by altering the tissue structure.

Finally, a multiscale formulation for the description of the viscoelastic properties of in vitro actin networks, by including the micro-structure, is discussed. In a first step the single filament response of F-actin is captured by a worm-like chain model including the extensibility of the filament, while in a second step the 3D biopolymer network is analyzed by using the microsphere model which accounts for the filaments equally distributed in space. A finite-element simulation of the aspiration of a droplet in a micropipette allows for further insights of the mechanical behavior of actin networks.