Computational Modeling in Cardiovascular Mechanics

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Cardiovascular mechanics is devoted to (computational) modeling processes of the circulatory system to address questions in the area of cardiovascular pathologies, interventional treatments, surgery, tissue engineering and device technologies among others. The motivation for research in these areas is the increasing affliction of the population with the arterial occlusive disease for which atherosclerosis is the primary cause. Atherosclerosis leads to complications such as myocardial infarction and stroke which are among the major causes of serious morbidity and death in the Western World.

Cardiovascular mechanics demands multidisciplinary research and knowledge from applied mechanicians, bioengineers, basic and computer scientists, and clinicians is required to gain more insights. This Minisymposium is on physical and computational models in both cardiovascular solid and fluid mechanics, with the focus on mechanobiological processes to provide a deeper understanding on the response of the cardiovascular system to mechanical loads. It focuses on the material and computational modelling of heart (i.e. the pump), the blood flow in the artery, and the vasculature (i.e. the arteries and veins through which the blood flows). In particular, welcome are mathematical descriptions relating (micro)-structure, mechanical response and biological processes (growth, remodelling). Approaches can be based either on a tissue or cellular level.

Specific topics of interest in the "Cardiovascular Mechanics" Minisymposium include:

- Computational models and algorithmic issues for simulations of the mechanics of the
  - vasculature such as arteries and veins (including mechanochemical formulations)
  - heart (including electro-chemo-mechanics)
  - blood flow and vascular wall interaction, heart-arterial interaction
- Cellular and molecular mechanics at micro- and nanoscale levels (e.g., endothelial, smooth muscle and red blood cells; cytoskeletal, membrane and nuclear rheology; cell migration and molecular motors; mechanotransduction)
- Vascular tissue mechanics including rupture, growth, remodeling, adaptation and repair
- Modeling of mechanobiological processes involved in the onset and progression of diseases of the circulatory system such as atherosclerosis, (vulnerable) plaques and aneurysms
- Computational modeling of medical treatments such as balloon angioplasty, bypass surgery, (endovascular) aneurysm repair, vascular anastomosis
- Medical device technology including stent, graft, heart valve prosthesis and their interaction with surrounding biological tissues
- Mass transport (i.e. transport of oxygen, albumin, carbon dioxide) within the vasculature
- In vivo and in vitro imaging and (dynamic) modeling based on MRI, CT, OCT, MDCT and IVUS modalities