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COMPUTATIONAL MULTIPHYSICS MODELING OF CARDIOVASCULAR SYSTEMS

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ABSTRACT

The field of computational modeling and simulation in cardiovascular biomechanics and biomedicine has seen rapid advancement in the recent years. Computational modeling of cardiovascular phenomena provides a non-invasive modality for understanding the underlying mechanics of cardiovascular diseases, as well as guiding device design and treatment planning. The future of computational cardiovascular biomechanics lies in patient-specific simulation of real disease events, enabling simulation assisted diagnostics, device design and deployment, and treatment planning decisions. The primary challenge in this regard is that patient-specific phenomena involve the synergistic interplay of multiple underlying physical or chemical processes, coupled to each other across several spatial and temporal scales. Computational multiphysics modeling has thus gradually emerged as a new frontier in advanced modeling of cardiovascular systems, aiming to resolve physiological and pathological phenomena in real patient-specific scenarios. Advancements in this field require engagement of engineering principles from various disciplines, and calls for inter-disciplinary research efforts that go beyond current multiscale computational mechanics approaches in cardiovascular biomechanics.

This minisymposium will bring together scientists working across various domains to provide a platform for discussing the state-of-the-art and future directions in multiphysics, multiscale modeling of cardiovascular systems. Fundamental as well as applied contributions from a wide range of topics focusing on theoretical and computational approaches for cardiovascular phenomena will be discussed. The term multiphysics in this context refers to coupled physical interactions including not only fundamental fluid and solid mechanics, but also multiscale transport phenomena, biological growth and remodeling, electrophysiology, biochemical interactions including drug delivery and other related aspects. The topics include (but are not restricted to):

- Coupled multiphysics models for cardiac mechanics.
- Multiphysics and multiscale models for vascular biology and biomechanics – arterial and venous systems.
- Patient-specific multiphysics modeling of cardiovascular diseases – stroke, thrombosis, atherosclerosis, embolisms.
- Numerical methods and algorithms for multiphysics coupling – staggered and monolithic approaches; mesh-based, mesh-free, and particle based methods.
- Assimilation of experimental data into multiphysics models.
- Integration of cardiovascular imaging into multiphysics models.
- Applications in cardiovascular surgical treatments for patients.
- Applications in design, deployment, and operation of endovascular devices in vivo.
- Thrombotic and embolic risk assessment for biomedical devices and mechanically assisted circulation.
- Computational tools and specialized software for multiphysics cardiovascular simulations.

As per participation in prior versions of this minisymposium, we anticípate around 15-20 abstracts, and around 50-100 attendees.