Computational Fluid Dynamics for Cardiovascular Flows

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ABSTRACT

The modeling of blood flow in the cardiovascular system and the heart shows multiple and different challenges [1, 2]. First, the flow in the heart chambers and large vessels is pulsatile and exhibits a transitional regime to turbulence. Second, modeling the cardiovascular system calls for addressing very different spatial scales, from capillaries to major vessels and the heart, for which a geometric multiscale approach is beneficial [3]. Finally, the blood flow is coupled to surrounding and immersed tissues such as vessel walls, the myocardium, cardiac valves – both native and prosthetic – as well as, possibly, stents and grafts. Most notably, the active contraction and relaxation of the heart drives the intra-cardiac hemodynamics. All these mutually interacting effects must be properly accounted for, either in a multiphysics modeling framework, or by means of clinical data assimilation techniques.

This minisymposium aims at gathering recent developments in computational fluid dynamics and fluid-structure interaction for the cardiovascular system, as well as advanced numerical discretization methods, meshing procedures, model validation, algorithms for model personalization, and data assimilation in clinical applications and translational medicine. The minisymposium welcomes contributions in high performance computing and reduced order modeling, also exploiting Machine and Deep Learning algorithms, for enhancing computational efficiency and providing fast quantitative responses that can complement diagnostics, therapeutics, and decision-making clinical procedures [4].

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