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# PHYSICS-BASED AND DATA-DRIVEN METHODS FOR COMPUTATIONAL CARDIOLOGY

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## ABSTRACT

Cardiac in silico models have seen rapid advancements in recent years and are increasingly recognized in the context of clinical cardiology. These models represent indeed a promising tool to address cardiovascular diseases and quantitatively analyse clinical data. Through numerical simulations of cardiac electromechanics and hemodynamics, it is possible to (i) reveal mechanistic links between microscopic and macroscopic quantities, (ii) perform in silico investigations of the effects of drugs or therapies, (iii) support the interpretation of clinical data and (iv) personalize therapies. In this regard, a major challenge for effective clinical exploitation of cardiac computational tools consists of the patient-specific customization of models, which requires the integration of complex, heterogeneous and often high-dimensional data within multiscale simulations. However, the high computational cost that characterizes the numerical simulations of the human heart, on one hand, and the strict timeline that clinical practice requires, on the other hand, call for the development of innovative methodologies and for a multidisciplinary effort involving the synergistic work of biophysicists, mathematicians, bioengineers, software engineers and data scientists. The challenge is to efficiently integrate physics and data, by blending numerical solvers based on mathematical models with Machine Learning techniques to extract the information contained in the clinical data. In this framework, the sinergy between physics based and data-driven approaches provides efficient and effective model-data fusion for clinical explotaition

This mini-symposium aims at bringing together scientists from different domains to discuss the state of the art and future lines of research towards the development of increasingly detailed cardiac computational models and towards an increasingly effective integration between clinical data and numerical simulations. Topics may include (but are not limited to): coupled cardiac models of cardiac mechanics, electrophysiology, fluid dynamics,

hemodynamics; numerical methods for large scale cardiac simulations; Machine Learning methods for cardiac applications; integration of experimental data and imaging data into multiphysics models; patient-specific modeling of cardiovascular diseases.

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