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ADVANCEMENTS IN COMPUTATIONAL MODELING FOR PERSONALIZED DIGITAL TWINS IN HEALTHCARE

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ABSTRACT

Computational modeling plays a pivotal role in advancing our understanding of human physiology and pathology, addressing the complexity of multiscale and multiphysics processes. To simulate such phenomena effectively, it is crucial to develop accurate mathematical models and robust numerical methods. Additionally, to enable clinical translation and digital twinning, highly efficient and cost-effective techniques for model personalization are needed.

Recent advancements in merging Scientific Machine Learning with Scientific Computing offer promising avenues for near-real-time accurate model predictions in healthcare. These methods, based on techniques such as Gaussian Processes, Neural Networks, and Reduced Order Models, provide reliable surrogates of complex biological phenomena by leveraging large amounts of data at a lower computing cost than traditional physics-based models. In addition, novel approaches combining physics-based and data-driven methodologies, like Physics-informed Machine Learning, have proved effective in solving inverse problems solving inverse problems in various biomedical fields.

This mini-symposium will bring together applied mathematicians, biomedical engineers, and clinicians developing numerical and data-driven methods in computational medicine. Topics of interest include the development and application of reduced order models for biomedical applications, machine learning techniques for patient-specific model parameterization and optimization, data-driven approaches for real-time model calibration and simulation, integration of multi-scale models with clinical data for personalized medicine, and industrial applications of medical digital twins in device design and testing. By fostering discussions on these cutting-edge topics, we aim to support future collaborations and expand the international research network in the emerging field of digital health and medical digital twins.