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Efficient identification of biomechanical properties in cardiac models based on physics-informed neural networks

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The development of biophysical models of the cardiovascular system is rapidly advancing in the research community, thanks to their predictive nature and their ability to assist the interpretation of clinical data [1]. However, high-resolution and accurate multi-physics mathematical models are computationally expensive and their personalisation involves fine calibration of a large number of parameters, challenging their clinical translation. In this talk a novel methodology is proposed, which relies on the integration of physics-informed neural networks methodologies [2] with high-resolution three-dimensional cardiac biomechanical models, to generate robust and effective surrogate reduced-order models capable of reconstructing displacement fields and estimating patient-specific biophysical properties. The proposed learning algorithm encodes information from displacement data, that can be routinely acquired in the clinical setting, and combines it with the physics of the problem, represented by a mathematical model based on partial differential equations, to regularise the problem and improve its convergence properties. Several benchmarks are presented to show the accuracy and robustness of the proposed method and its great potential to enable the robust and effective identification of patient-specific physical properties.

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