Multiphysics, multiscale, and computational models for the human heart: towards the construction of cardiac digital twins

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We present novel 4-chambers model of the human heart. We couple state-of-the art models of electrophysiology, mechanical activation, passive mechanical response, and blood circulation, leading to a coupled electromechanical problem. Our multiscale model is numerically coupled by means of partitioned-staggered numerical schemes. We numerically solve the model in the HPC framework to obtain physiologically meaningful biomarkers. We also present a Machine Learning method for real-time numerical simulations that allows efficient construction of cardiac digital twins.