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IN-SILICO *vs.* IN-VIVO: ACCURACY AND RELIABILITY OF PATIENT-SPECIFIC CARDIAC MODELING

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ABSTRACT

Recent years have seen a humongous proliferation of personalized cardiac models of varying degree of complexity – from image-driven computational fluid dynamics (CFD) simulations, to electro-mechanical models, until recent fully-coupled multi-physics digital twins of the heart. The long-term objective of these developments is twofold: i) to replicate the status of a patient's heart with access to information otherwise not obtainable by clinical imaging; ii) to predict hypothetical post-treatment scenarios and guide clinical decisions. Despite the enormous advances, the validation of these models against *in-vivo* clinical data of the same patient (e.g. CT, cine-MRI, 4D flow MRI, echo-PIV, etc.) remains elusive. Identifying the *minimum set* of modeling ingredients needed to replicate fundamental physiological features of heart function, as well as detailed flow, stress/strain or electric fields is a crucial point towards the incorporation of *in-silico* replicas into clinical practice. The impact of the uncertainties associated with the estimation of modeling parameters and with boundary conditions, as well as with the clinical data itself is also of utmost importance.

The proposed mini-symposium will bring together experts form the modeling, biomedical and clinical imaging communities to discuss the state-of-the-art in this field and explore future research directions. Topics of interest include (but are not limited to):

- *medical imaging techniques*: validation of algorithms for cardiac shape/motion reconstruction, physics-based and data-driven enhancement of imaging data;
- *image-driven CFD simulations*: comparisons against clinical imaging data (e.g. 4D flow MRI), impact of detailed valve modeling, incorporation of complex anatomical features, effect of boundary conditions;
- *multi-physics cardiac modeling*: calibration of model parameters; comparisons against stress/strain, flow and electric fields;
- role of machine-learning techniques in patient-specific cardiac simulations;

Studies focusing on the application of patient-specific cardiac models to real or virtual patient populations are also welcome.