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FAST MODELS OF THE MYOCARDIUM FOR MODEL-BASED DIAGNOSIS AND THERAPY PLANNING IN THE CLINICAL ENVIRONMENT

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Abstract

Simulation of the cardiac electromechanical activity is a very active research area. Recent progress in the understanding of cardiac function and in the modelling capabilities made an integrative model of the heart conceivable. However, most of the available models are designed for the normal heart function and built from animal models or ex vivo studies. Moreover, few techniques are available to estimate the parameters of these models from medical observations. Adjusting such models to patient data and simulating cardiovascular pathologies is of great clinical interest but still very challenging. Finally, due to the important time constraints of clinical applications, the computational cost of the models must be reduced. Therefore, the design of dedicated models with a complexity compatible with the available data is crucial.

The XMR facility in King's College London, UK, which includes a MR scanner and a X-ray c-arm, allows registration of the MR and X-ray information. By integrating these different modalities, we can obtain rich data, including anatomy, electrophysiology and motion. Such an approach allows multiple validations, by testing a variety of patient-specific models against in vivo clinical data. Furthermore, these validations will guide the model design and future improvements. The various pathologies assessed during interventions will determine which parameters have to be included in the model, and how they need to be modified in order to reproduce abnormal cardiac function. It is crucial to ensure that the chosen model is not only able to reproduce the observed pathological behaviour but also able to provide predictive insights on the intervention procedure.

The introduction of models in a clinical set-up opens up possibilities to compare the behaviour of the model with patient data before and after intervention.