

The computational mechanics of the Heart

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Abstract

The significance of heart disease has motivated the application of state of the art clinical imaging techniques to aid diagnosis and clinical planning. However to exploit the full value of such imaging technologies, and the combined information content they produce, requires the ability to integrate multiple types of functional data into a consistent modeling framework. An exciting and highly promising strategy for underpinning this integration is the assimilation of multiple image sets into personalised and biophysically consistent mathematical models. The development of these models provides the ability to capture the multi-factorial cause and effect relationships that link the underlying pathophysiological mechanisms. Applying this approach I will present the development and application of a computational cardiac framework representing the cardiac electrical, mechanical and fluid systems and related functions. Through the development of these computational models, I will show results quantifying the importance of each of these coupling effects and discuss their significance for interpreting measurement data and for predicting cardiac function. I will outline future planned developments for integrating these three systems together in the heart, and the common features and tools of relevant for developing other system models.