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ESTIMATION OF PATIENT-SPECIFIC PARAMETERS IN MECHANICAL MODELLING OF DILATED CARDIOMYOPATHY

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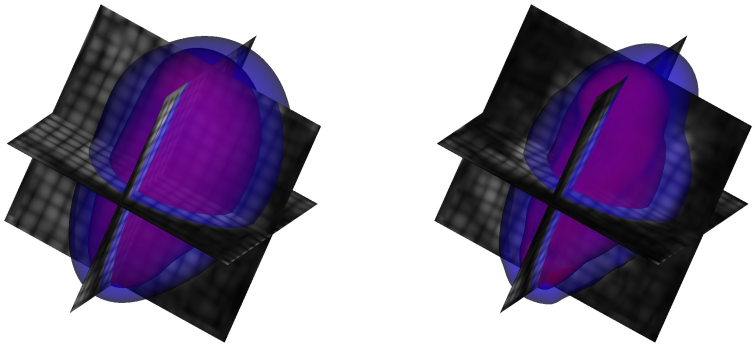
Dilated cardiomyopathy (DCM) is a medical condition characterised by abnormal increase in ventricular volume and impaired function of the heart muscle, associated with heart failure and sudden cardiac death [2]. The treatment of DCM patients may consist of drug therapy, pacing, or surgery, all of which are aimed at improving the contractile function of the left ventricle. This is often assessed with global measures, such as ejection fractions, pressure-volume loops and bulk stress estimates.

A better understanding of the underlying mechanics can be achieved through the study of myocardial heterogeneities and local stress variations [6]. This is made possible by computational modelling, which makes use the fundamental physical laws to simulate behaviour of physiological systems. The diagnostic and prognostic capabilities of computational models rely on realistic representation of the myocardial properties via model parameters [1, 3].

We perform a series of tests to establish the identifiability of constitutive parameters in simulations of passive inflation of an idealised left ventricle using the reduced-order unscented Kalman filter [4]. Sensitivity analysis is carried out through adding varying levels of noise at different stages of the *in silico* process, specifically before and after image processing. Several nonlinear stress-strain relationships are compared on the basis of their suitability for parameter identification. Finally, we apply the methodology for in full cardiac cycle simulations, and present the results of the estimation for a group of DCM patients and healthy volunteers based on high-resolution 3D SSFP MR images. The estimation procedure was aimed at achieving the best possible representation of myocardial deformations extracted from time-resolved 3D-tagged MR images [5] (see Figure 1).



(a) LV model at ED (b) LV model at ED+278ms

Figure 1: The model of the left ventricle (LV) constructed at end-diastole (ED) and deformed according to the displacement field extracted from 3D-tagged MRI in mid-systole (ED+278ms).

The use of patient-specific modelling enables quantitative comparisons between cardiac function in DCM patients and healthy volunteers.

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