**Nordsletten \_ 2019 ML-MSM Meeting - Abstract Submission Form**

**Title: Towards Automated Biomechanical Analysis of Patients with Hypertrophic Cardiomyopathy**

**PI(s) Grant: David Nordsletten**

**Institution(s): Kings College London**

**Grant Number: EPSRC HTCA: EP/R003866/1 and EP/N011554/1**

**Title of Grant: Adaptive, Multiscale, Data-infused Cardiac Biomechanics Modeling for Diagnostic and Prognostic Assessment**

**Abstract Authors:** Renee Miller, Eric Kerfoot, Charlene Mauger, Alistair Young, David Nordsletten

**Abstract Text:**

*Hypertrophic cardiomyopathy (HCM), a genetic disease characterised by an abnormal thickening of the ventricular myocardium, affects up to 1 in 200 people. Clinical challenges in HCM include patient risk stratification (heart failure and sudden cardiac death) as well as drug or surgical (myectomy or alcohol septal ablation) therapy planning. With enhanced imaging capabilities, computational models provide a unique tool that can be developed in order to study the mechanics of HCM hearts, potentially uncovering new markers with which clinicians can use to stratify patients into risk groups and plan therapies. Typically, patient-specific modelling requires time-consuming manual segmentation of the myocardium from short and long-axis images by an expert. We present a semi-automated pipeline and analysis tool for simulating the biventricular heartbeat in HCM patients using only MR images collected from a standard clinical protocol.*

*A U-net convolutional neural network architecture, built from residual units, was used to label the left ventricular blood pool, left ventricular myocardium and right ventricular blood pool. The network was trained on 1264 long axis and 9095 short-axis images, from both Philips and Siemens scanners segmented at both end-systole and end-diastole. Typical data augmentation steps such as flip, transpose, translation and rotation were performed as well as free-form deformation in order to add shape variation. Minimal cleaning was performed of the resulting masks prior to fitting surface meshes to the endocardial and epicardial contours.*

*Volume curves derived from short-axis blood pool labels were then used to drive passive inflation and constrain active contraction in the biventricular models. Novel boundary conditions were applied controlling valve plane motion through the use of data-derived boundary energies, rather than Dirichlet conditions. These steps describe a rapid semi-automated pipeline, utilising a neural network for image segmentation, for generating patient-specific biventricular models in a cohort of HCM patients.*