Modeling Myocardial Fibrosis Improves ECG-Based Inference in Dilated Cardiomyopathy

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Abstract

Myocardial fibrosis is a key structural feature of dilated cardiomyopathy (DCM) and plays a critical role in altering ventricular activation patterns. However, its impact on reduced-order electrophysiological models used for ECG fitting remains insufficiently explored. In this work, we investigate the effect of incorporating fibrosis into a reduced-order Eikonal-based inference model for approximating the QRS complex in a patient with idiopathic DCM. Patient-specific fibrotic regions were derived from late gadolinium-enhanced magnetic resonance imaging (LGE-MRI) and incorporated into the computational model after being manually segmented by a clinician. The QRS complex was approximated under two modeling assumptions: (i) without explicit representation of fibrosis, using a globally reduced conduction velocity, and (ii) with spatially resolved fibrotic regions affecting conduction. Preliminary results show that, without modeling fibrosis, the QRS complex was approximated with a mean Pearson correlation coefficient (PCC) of 0.87 by reducing the reference conduction velocity by 80%. When fibrotic regions were incorporated with a slow conduction velocity close to zero, the model achieved a PCC of 0.90, indicating improved agreement with clinical electrocardiography. These findings suggest that explicitly modeling fibrosis provides a more physiologically consistent representation of conduction abnormalities in DCM and improves ECG-based inference, supporting its inclusion in reduced-order cardiac digital twin models.