Patients-specific analysis of myocardial strains in left bundle branch block based on computational models

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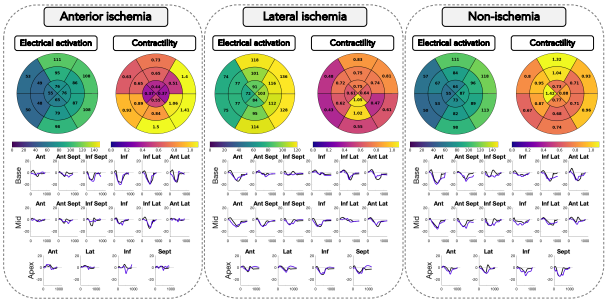
Background: Cardiac resynchronization therapy (CRT) has become an important treatment option in patients with typical left bundle branch block (LBBB). However, approximately 30% of patients undergoing CRT show little or no improvement. Although echocardiography could bring essential information concerning LV dyssynchrony, the interpretation of echocardiographic strains could be difficult due the complexity of mechanisms involved in cardiac contraction. **Methods:** We propose a patient-specific model-based approach of the cardiovascular system in order to assist the analysis and to improve the interpretability of myocardial strains. The left ventricle (LV) was divided into 16 segments in order to evaluate concurrently different regions at the ventricular contraction process. For each LV segment, some parameters, associated with active and passive components of the cardiac muscle and electrical depolarization time, were identified using Evolutionnary Algorithms. The proposed approach was evaluated on data obtained from 3 LBBB patients. **Results:** A close match was observed between experimental and simulated myocardial strain curves for all the subjects. The RMSE is equal to $2.87(\pm 1.00)$, $2.49(\pm 0.55)$ and $3.63(\pm 0.81)$ for the anterior ischemic, the lateral ischemic and the non-ischemic LBBB patients, respectively. Contractility bull's-eye results estimated from the model-based approach allow ischemic and non-ischemic cases distinction, where low levels of contractility could be associated with damaged tissues.



Myocardial strain signals obtained from clinical data (blue) and patient-specific simulations (black). Bull's-eye representations of the segmental activation delay (left) and contractility (right) for the 3 LBBB patients.