Cardiac Activation Maps Reconstruction A Comparative Study Between Data-Driven and Physics-Based Methods

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Abstract

One of the essential diagnostic tools of cardiac arrhythmia is activation mapping. Non- invasive current mapping procedures include electrocardiographic imaging. It allows reconstructing heart surface potentials from measured body surface potentials. Then, activation maps are generated using the heart surface potentials. The new approach we developped is to deploy artificial neural networks to estimate activation maps directly from body surface potential measurements. Here we carry out a comparative study between the data-driven approach DirectMap and noninvasive classic technique based on reconstructed heart surface potentials using both Finite element method combined with L1-norm regularization (FEM-L1) and the spatial adaptation of Time-delay neural networks (SATDNN-AT). In this work, we assess the performance of the three approaches using a synthetic single paced-rhythm dataset generated on the atria surface. The results show that data-driven approach DirectMap quantitatively outperforms the two other methods. In fact, we observe an absolute activation time error and a correlation coefficient, respectively, equal to 7.20 ms, 93.2% using DirectMap, 14.60 ms, 76.2% using FEM-L1 and 13.58 ms, 79.6% using SATDNN-AT. In addition, results show that data-driven approaches (DirectMap and SATDNN-AT) are strongly robust against additive gaussian noise compared to FEM-L1.