Non-Invasive Estimation of Atrial Fibrosis Location and Density

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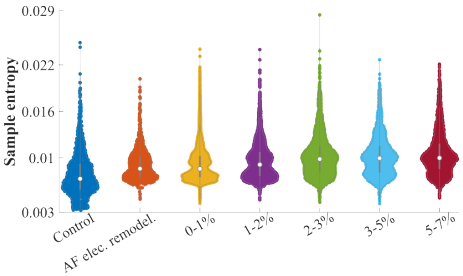
Fibrosis alters atrial conduction properties of the cardiac tissue which increases the probability of suffering atrial fibrillation (AF). However, the exact mechanism of this association are not fully understood. Fibrosis is presented in different densities and locations of the atria and the commonly used techniques to diagnose fibrosis are intrusive. This study focus on a non-invasice method, body surface potential mapping (BSPM), to study how different densities and locations of fibrosis affect on the morphology of the P-wave.

The BSPMs are obtained from monodomain simulations of six distinct patterns and eight different locations of fibrosis on a realistic atrial model. The metrics employed to quantify the changes on the P-wave are the sample entropy (SE) and the area under the curve (AUC).

Higher densities of fibrosis result in ECG signals with more fractionation and therefore, the SE values showed to increased for higher densities of fibrosis. For instance, the SE was 1.16 times greater in cases with a fibrosis density of 5-7% than in those with a density of 0-1%. The AUC computed for all simulations was compared to the AUC of the AF electrical remodeling. The cases with fibrosis in the same regions exhibited similar textures, and changes in fibrosis density only modified the amplitude values. Therefore, the location of fibrosis can be extracted from the AUC values.



SE values for control, AF electrical remodeling and different intervals of fibrosis density.

This study shows that the SE may serve as a valuable metric to assess fibrosis density, while the AUC may allow for the localization of fibrosis. The findings of this study help in the understanding of the association between P-wave morphology and fibrosis, and have potential applications in personalized treatments.