Mathematical Simulation of the Electrical Activity of the Heart

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Heart diseases are the leading cause death in the world. With the recent developments in scientific computing, numerical modeling starts to play a crucial role and provides the necessary tools for understanding rhythm disorders of the heart. However, efficient three-dimensional simulations of the electrical waves in the human heart are not yet feasible. The major difficulty is that the action potential is a wave with sharp depolarization and re-polarization fronts.
In this work, an efficient mathematical method will be presented for simulating the electrical activity of the human heart. The main purpose of these simulations is to accurately predict the depolarization/re-polarization front position, which is essential to the understanding of the electrical activity of the myocardium. The numerical method proposed is based on a time-dependent anisotropic remeshing algorithm. A monodomain and bidomain models, that give the best reflection of the electrical waves in cardiac tissue, will be employed for the numerical simulations. Numerical examples will be presented to illustrate the accuracy and efficiency of the proposed method.