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# Efficient Representations of Cardiac Spatial Heterogeneity in Computational Models

Alejandro Nieto-Ramos
*Rochester Institute of Technology*, axn2780@rit.edu

Elizabeth Cherry
*Rochester Institute of Technology*, excsma@rit.edu

It is generally assumed that all cells in models of the electrical behavior of cardiac tissue have the same properties. However, there are intrinsic differences in cardiac cells that are not well characterized but cause spatial heterogeneity of the electrical properties in tissue. Optical mapping techniques can be used to obtain experimental data from cardiac surfaces at high spatial resolution (128x128 pixels), but it would be prohibitive to develop individualized model parameterizations for each pixel. Instead, variations in model parameters can be defined on a coarser grid, which, given the costs associated with parameterizing models from data, would allow a representation of heterogeneous tissue to be obtained more efficiently.

Here, we address how coarse the parameterization grid can be while still obtaining accurate results for complicated dynamical states of spatially discordant alternans, in which the wavelength of propagating electrical waves varies significantly over space. We use the Fenton-Karma model with heterogeneity included as a smooth nonlinear gradient over space for more model parameters. To obtain the more efficient representations, we set parameter values everywhere in space based on the assumption that the exact parameter values are known at the points of the coarser grid; we assume the parameter values could be obtained from experimental data. Specifically, we assign parameter values in space by fitting either a piecewise-constant or piecewise-linear function to the spatially coarse known data. We wish to identify the maximal grid spacing of such points to obtain good agreement with spatial profiles of action potential duration during complex states. We find that coarse grid spacing of about 1.0-1.6 cm generally results in spatial profiles that agree well with the true profiles for a range of different model parameters and different functions of those parameters over space. In addition, the piecewise-constant and piecewise-linear functions perform similarly, with neither choice providing a clear advantage. Our results to date suggest that matching the output of models of cardiac tissue to heterogeneous experimental data can be done efficiently, even during complex dynamical states, and holds promise for more accurate modeling of individual experiments.