# Adaptive High Order Nodal Finite Elements on Simplices For Electrocardiological Models

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We present an implementation of a pseudo-spectral scheme on unstructured simplices to solve the bidomain equations. They describe the macroscale electrical activity of cardiac tissue and is coupled to a cellular model, such as the Luo-Rudy '91 model (C.H. Luo and Y. Rudy. A model of the ventricular cardiac action potential-depolarisation, repolarisation and their interaction. Circulation Research, 68:1501-1526, 1991). The interaction of many different spatial and temporal scales makes this model difficult to solve accurately.

We describe an explicit method for the construction of nodes that are suitable for polynomial interpolation on simplices. These nodes are used in our implementation of the pseudo-spectral scheme. They show a performance on par with Fekete nodes up to 12th order. However, their very simple construction makes them much more desirable.

The bidomain model is solved using an adaptive method in both time and space. All known approaches to time and space adaptivity applied to this problem have concentrated on the use of low order methods. Our spatial discretisation is a high order h-adaptive continuous Galerkin method which is coupled to an adaptive linearly implicit Rosenbrock time integration scheme. The spatial mesh size is determined by the gradient of the transmembrane and extracellular potentials. We also show high order an h-adaptive discontinuous Galerkin method which is coupled to an adaptive linearly implicit Rosenbrock time integration scheme. Both these approaches are compared in terms of computational time and accuracy.

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