Nagaiah Chamakuri (Johann Radon Institute for Computational and Applied Mathematics, Linz, Austria)

Large scale PDE constrained optimization of cardiac defibrillation

Abstract
In this talk we present a feasible study of optimal control techniques for cardiac defibrillation on the basis of the bidomain-bath equations posed on a realistic rabbit ventricle geometry. The bidomain model consists of a system of elliptic partial differential equations coupled with a non-linear parabolic equation of reaction-diffusion type, where the reaction term, modeling ionic transport is described by a set of ordinary differential equations. The bidomain model is coupled with the quasi-static Maxwell's equation to consider the effect of an external bathing medium.

The optimal control approach is based on minimizing a properly chosen cost functional depending on the extracellular current as input at the boundary of torso domain, which must be determined in such a way that wave fronts of transmembrane voltage in cardiac tissue are smoothed in an optimal manner. The existence and uniqueness of a weak solution for the primal and dual problems, the derivation of the optimality system and the description of its discretisation is given. In parallel computations, the domain decomposition of such realistic geometry consists of heart surrounded by torso is not a trivial task. I will present domain decomposition techniques and their efficient implementation of such PDE constrained optimization of bidomain model. The parallel algorithm efficiency is demonstrated not only for the direct problem but also for the optimal control problem.