15th International Conference on Domain Decomposition Methods
July 21-25, 2003, Berlin, Germany

The Mortar Finite Element Method in Computational Electrocardiology

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Abstract: The excitation process in the myocardium can be described by the evolution of the transmembrane and extracellular potentials, which are solutions of a reaction diffusion (R–D) system. This system is still unpractical for realistic simulations due to its computational cost.
A non–conforming non–overlapping domain decomposition method is proposed to overcome the computational costs caused by the narrow cardiac excitation wavefront. By appropriate estimation of the transmembrane potential, the part of the domain requiring a finer grid, typically the regions closed to the cardiac wavefront, is determined. Then, this part is cut out and a new finer grid can be constructed allowing a more accurate computation near the wavefront. Finally, using the mortar finite element method, the matching of different discretizations on adjacent subdomains can be weakly enforced.
The numerical technique is first applied to the elliptic bidomain equation of the extracellular potential and then to the R-D system starting with the case of "equal anisotropy ratio" that allows to work only with a parabolic equation.
The performance of the numerical technique is investigated showing its efficiency if compared with the classical conforming FEM.

[1] M. Pennacchio, *The mortar finite element method for the cardiac "bidomain" model of extracellular potential*, to appear on J. Sci. Comp.

Type of contribution: Talk
Location: Lecture Room, **Time:** Monday, 21 July, 11:40

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