

Essen, 31.10.08

## **Seminar Mechanik und Numerische Mathematik**

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### **„Multilevel Schwarz preconditioners for cardiac Bidomain models and applications“**

We construct and analyze multilevel additive Schwarz preconditioners for the anisotropic cardiac Bidomain and Monodomain models in three dimensions. To date, the Bidomain system is the most complete model of the bioelectrical activity of the heart tissue, consisting of a degenerate parabolic system of nonlinear reaction-diffusion equations coupled with a stiff system of several ordinary differential equations describing the dynamics of ionic currents through the cellular membrane. Due to the presence of very different scales in both space and time, the numerical discretization of this system by finite elements in space and semi-implicit methods in time produces very ill-conditioned linear systems that must be solved at each time step. The proposed multilevel algorithm employs a hierarchy of nested meshes with overlapping Schwarz preconditioners on each level and is fully additive, hence parallel, within and among levels. Convergence estimates can be proved, showing that the convergence rate of the resulting multilevel algorithm is independent of the number of subdomains (scalability), of the mesh sizes of each level and of the number of levels (optimality). Parallel numerical results, using the PETSc library and run on Linux Clusters, confirm the scalability and optimality of the method, as well as its parallel efficiency for large-scale simulations of a complete cardiac cycle on both cartesian and deformed domains in three dimensions. The resulting parallel solver has been employed in several simulation studies of ventricular repolarization in presence of M-cells and ischemic regions.

**Ort:** Universität Duisburg-Essen, Campus Essen, **Raum T03 R03 D26**

**Zeit:** Freitag, den 14.11.2008 von 12.00 Uhr bis 13.00 Uhr

**gez. Prof. Dr. A. Klawonn**

**gez. Prof. Dr.-Ing. J. Schröder**