KTH SOLID MECHANICS SEMINAR; Thursday, August 21st, 13.15; KTH Solid Mechanics Seminar room

Christoph Augustin "Strongly scalable parallel simulations of high-resolution models in computational cardiology"

Anatomically realistic and biophysically detailed multiscale computer models of cardiovascular tissues like the heart or arterial vessels are playing an increasingly important role in advancing our understanding of integrated cardiac function in health and disease. However, such detailed multiphysics simulations are computationally vastly demanding. While current trends in high performance computing (HPC) hardware promise to alleviate this problem, exploiting the potential of such architectures remains challenging for various reasons. On one hand, strongly scalable algorithms are necessitated to achieve a sufficient reduction in execution time by engaging a large number of cores, and, on the other hand, alternative acceleration technologies such as graphics processing units (GPUs) are playing an increasingly important role which imposes further constraints on design and implementation of solver codes. We briefly discuss two different parallel approaches, the finite element tearing and interconnecting (FETI) method and a proper domain decomposition algebraic multigrid (AMG), to solve the problems arising from the simulation of the electrical and mechanical behavior of cardiovascular tissues. Strong scalability results for passive inflation and coupled electromechanical problems will be presented and we discuss advantages and limitations of the particular numerical methods.

Christoph Augustin is postdoctoral researcher at the Medical University of Graz (MUG) in Austria. He received the M.S. degree in technical mathematics and the Dr.Tech. degree in engineering science from Graz University of Technology in 2008 and in 2012, respectively.
Currently, he is working at the Institute of Biophysics in the computational cardiology group of Prof. Gernot Plank. His main research interests include multi-physics problems, in particular the electro-mechanical modeling of the heart, and their simulation using high-performance and massively parallel computing.

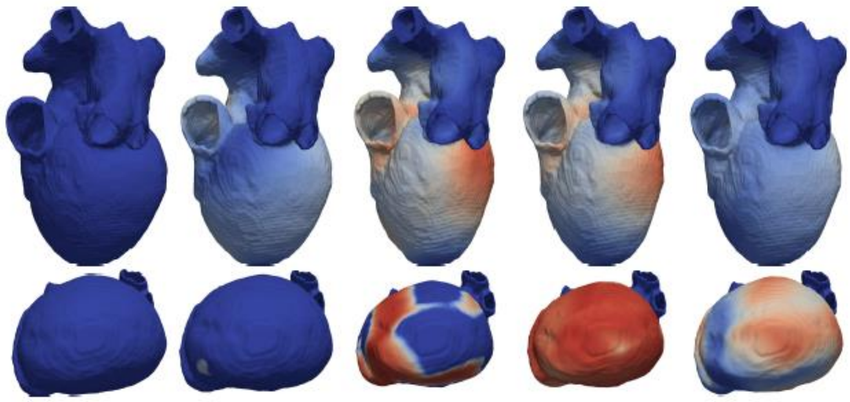

Figure: Electromechanical simulation using a human four chamber heart model showing the displacement on top and the active tension below. The underlying high-resolution mesh consists of 3 686 631 vertices and 20 524 957 tetrahedral elements. The simulation was performed on Super-MUC of the Leibniz Supercomputing Center in Munich using up to 4 096 cores.