ICAMS Special Seminar

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Room IC FW 02/718, 2:00 p.m.

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FE2TI - Combining Computational Homogenization and Domain Decomposition Methods for the Simulation of Dual-Phase Steel

The computational simulation of modern high-strength steel materials with micro structure is still a challenge. As a computational homogenization approach we combine the FE^2 method combined with efficient parallel domain decomposition methods of FETI-DP type as well as an efficient and parallel scalable algebraic multigrid method, resulting in the software package FE2TI. In the FE^2 approach, in each Gauss integration point of the macroscopic problem, a microscopic problem on a representative volume element (RVE) is solved. The microscopic problems are only coupled through the macroscopic level and can be solved all in parallel. In FE2TI, each of these microscopic problems itself will be solved using a parallel FETI-DP domain decomposition method and the macroscopic problem is either solved by a direct solver or by an algebraic multigrid preconditioner in combination with a Krylov space method. This approach is implemented in PETSc and uses efficient solver packages including BoomerAMG, MUMPS, and UMFPACK. We present weak parallel scalability results obtained with more than a million MPI ranks and show that our software scales on different computing architectures. One of our goals is to work towards virtually performing the Nakajima test, a contact problem well-known from material testing. The current state of the FE2TI software for performing this test will be shown.

This work has been carried out within EXASTEEL, a project of the DFG priority program SPP1648 „Software for Exascale Computing“.