Gabriel Wittum

UG 4 - a novel multigrid software system for the simulation of pde-based models.

G-CSC
Universitt Frankfurt
Kettenhofweg 139
60325 Frankfurt am Main
Germany
wittum@g-csc.de

Numerical simulation has become one of the major topics in Computational Science. To promote modelling and simulation of complex problems new strategies are needed allowing for the solution of large, complex model systems. Crucial issues for such strategies are reliability, efficiency, robustness, usability, and versatility.

After discussing the needs of large-scale simulation we point out basic simulation strategies such as adaptivity, parallelism and multigrid solvers. To allow adaptive, parallel computations the load balancing problem for dynamically chaniging grids has to be solved efficiently by fast heuristics. These strategies are combined in the novel simulation system UG 4 (Unstructured Grids) being presented in the following. In addition to these methodological features, a new GUI concept for reducing complexity in handling and controlling the simulation and the software is presented.

In the second part of the talk we show the performance and efficiency of this strategy in various applications. In particular large scale parallel computations of density-driven groundwater flow as well as some non-standard problems from biotechnology and medicine are discussed in more detail. We present a new model for biomass fermentation and for signal processing in neurons in three space dimensions.