Matthias Bolten

Advanced smoothing techniques and aggressive coarsening for massively parallel multigrid

Universität Kassel
Institut für Mathematik
Heinrich-Plett-Straße 40
34132 Kassel
Germany
bolten@mathematik.uni-kassel.de

Multigrid methods are amongst the most efficient methods for the solution of partial differential equations in a variety of applications, especially when the solution of elliptic partial differential equations is needed. They are used for many simulations in computational science and engineering, often requiring the use of supercomputers due to the vast problem size.

While parallel multigrid methods show an optimal scaling behavior on parallel computers that depends on the number of processors logarithmically, only, the large number of cores that is available nowadays on large supercomputers exposes this logarithmic factor. While this cannot be prevented, the use of aggressive coarsening can reduce this effect. In order to maintain the efficiency and good algorithmic scalability of multigrid methods, more powerful smoothing techniques have to be employed. Different options exist, including polynomial smoothers or block smoothers that are strongly connected to domain decomposition methods.

In this talk we will discuss the effect of aggressive coarsening in geometric multigrid methods and different smoothing techniques that in combination result in efficient multigrid methods. Analyses and the necessary techniques will be presented and the advantage of these techniques on large scale supercomputers and modern computer architectures will be highlighted.