

Project

Title: Hybrid High-Performance Computing Systems for Solvers of Sparse Systems of Linear Equations

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Summary

In simulation technology solvers for sparse systems of linear equations are basic building blocks required for many application domains like solving partial differential equations, computer algebra tools or engineering applications in general. As problem sizes increased by orders of magnitude over the years, the demand of fast solvers was accommodated by algorithmic improvements and parallelization. Parallelization has been achieved e.g. by domain decomposition methods modifying the algorithms for the parallel computation on e.g. clusters of general-purpose computers (PCs) widely used in high-performance simulation.

The focus of this project is to examine the potential of hybrid high-performance computing systems based on reconfigurable hardware components, general purpose graphics processing units and dedicated hardware components building hardware/software system for the acceleration of solvers for sparse systems of linear equations. Similar to the above mentioned domain decomposition, additional modifications of the solver algorithms are used to obtain high-performance results for these hybrid hardware/software systems. Especially reconfigurable hardware offers additional options to modify the algorithms on the bit level for performance optimization. With this approach the solution space is extended from the algorithmic level to the architectural level of the hybrid hardware/software system in order obtain an efficient high-performance computing system for fast solvers. Another important aspect is the system performance with respect to the degree of irregularity of the data structure and the required I/O-bandwidth. The goal is to design a compact hybrid high-performance computing system for fast solvers of sparse systems of linear equations and to identify efficient hardware building blocks for this application domain.