On a highly scalable infrastructure for massively parallel multigrid solvers

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Application of parallel geometric multigrid solvers on adaptively refined grids requires a careful design of the involved load-balancing and load-migration routines as well as fast communication between copies of distributed objects. In error-estimation based refinement strategies, multiple rebalancing steps may be required to provide a uniform element distribution between all processors in all steps. In order to perform such operations efficiently on supercomputers with millions of cores, one has to extend existing load balancing and communication schemes.

We outline the parallel infrastructure for distributed multigrid hierarchies in the simulation framework UG4 and present experimental scaling studies for our geometric multigrid solver on adaptive and non-adaptive grid hierarchies on up to 262144 processes. We focus on an efficient hierarchical organization of the involved processes, on efficient horizontal and vertical communication schemes as well as on the parallel refinement and load-balancing strategies used.