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Parallel grid library with adaptive mesh refinement for development of highly scalable simulations

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As the single CPU core performance is saturating while the number of cores in the fastest supercomputers increases exponentially, the parallel performance of simulations on distributed memory machines is crucial. At the same time, utilizing efficiently the large number of available cores presents a challenge, especially in simulations with run-time adaptive mesh refinement. We have developed a generic grid library (dccrg) aimed at finite volume simulations that is easy to use and scales well up to tens of thousands of cores. The grid has several attractive features: It 1) allows an arbitrary C++ class or structure to be used as cell data; 2) provides a simple interface for adaptive mesh refinement during a simulation; 3) encapsulates the details of MPI communication when updating the data of neighboring cells between processes; and 4) provides a simple interface to run-time load balancing, e.g. domain decomposition, through the Zoltan library. Dccrg is freely available for anyone to use, study and modify under the GNU Lesser General Public License v3. We will present the implementation of dccrg, simple and advanced usage examples and scalability results on various supercomputers and problems.