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Parallel grid library for rapid and flexible simulation development

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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 which can be the key to high performance. We have developed a generic grid library (dccrg) 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) is easy to use and provides a simple interface for run-time adaptive mesh refinement ; 3) transfers the data of neighboring cells between processes transparently and asynchronously; and 4) provides a simple interface to run-time load balancing, e.g. domain decomposition, through the Zoltan library. Dccrg is freely available from https://gitorious.org/dccrg for anyone to use, study and modify under the GNU Lesser General Public License version 3. We present an overview of the implementation of dccrg, its parallel scalability and several source code examples of its usage in different types of simulations.