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Abstract:

In this study, we present an Open MPI-parallelized implementation of the domain decomposer PARTEL for TELEMAC. The domain decomposer PARTEL splits the computational domain into several partitions, which forms the basis of parallel simulations. In current TELEMAC releases, only serial mode has been implemented in PARTEL, which comes along with some limitations regarding the number of elements as well as the number of partitions to be decomposed. Depending on the hardware resources used for testing, the serial mode of PARTEL might take a significantly long computation time or eventually fail due to exceeding the memory limit of the computer. To overcome this bottleneck we fully parallelized the domain decomposition using Open MPI. This approach allows us to decompose a huge domain consisting of some ten million cells into hundreds of subdomains utilizing the available HPC resources at the Leibniz Supercomputing Center Munich, Germany (LRZ).

Our work focused on improving PARTEL code within the official release of TELEMAC version v7p2r3. Original PARTEL covers the decomposition of the boundary conditions, initial conditions and the parallel information data as well as the graph decomposition for the geometry file, which were developed in our MPI optimized PARTEL applying different techniques: e.g. the code was decoupled; the loops were unrolled; however global data information was maintained and algorithm consistency was kept. Applying a MPI parallelization scheme the memory usage by a single MPI process of PARTEL was reduced theoretically by a factor of O(NPARTS), where NPARTS is the number of partitions. Our tests were performed on a HPC cluster called CoolMUC2 at the LRZ. For testing, a mesh of 20 million elements (case - I) and the other with 40 million elements (case - II) were used. The MPI-parallelized PARTEL was able to decompose the case-I-mesh into 1200 subdomains in approximately 25 minutes. In case - II, the program has completed the task with 600 subdomains generated in about 18 minutes. The tests were also done using the trunk version of TELEMAC, which is essentially equivalent to the major version 8. We observed that this version was not able to complete the tests in reasonable times (timed out after a few hours of running). Our concept can be extended to the later versions of TELEMAC in the future.

Proposed session: *Numerical methods, code coupling and high performance computing*
Key words: Domain decomposition, parallelization, Telemac, high performance computing,
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