

The Dawn of a New Era: The End of MPI?

Evaluating the benefits of the HPX model for usage in a massively parallel CFD solver

The Message Passing Interface (MPI) has been the working horse in HPC for the last three decades. With its standardized integration into C and FORTRAN, it still is the first address for computations on distributed-memory machines today. Nevertheless, the MPI programming model, requires low-level conducting and often leads to non-ideal utilization of compute resources. In addition, MPI does not support modern programming features, such as exception handling, RAII, strong typing, templating or work stealing.

In this work the HPX¹ model is to be evaluated as a potential candidate to replace MPI in our in-house compressible multi-phase finite volume solver. Therefore, well-known compute kernels are first rewritten in HPX and their performance analyzed. Afterwards HPX is brought into the main application if a performance increase was observed.

Tasks:

- Familiarization with HPX
- Implementation of kernels
- Benchmarking the kernels' (parallel) performance

Requirements:

- Knowledge of C++14
- Ability to work independently
- Knowledge of MPI
- Knowledge of Linux, HPX beneficial
- Experience with HPC-clusters, beneficial

Take-away:

- Insight into state-of-the-art programming models and testing and profiling tools.
- Experience with HPC-clusters
- Project management skills
- Improved C++ skills

¹ <https://github.com/STELLAR-GROUP/hpx>

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