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PRACTICAL ASPECTS OF ADVANCED CFD SIMULATIONS ON EMERGING MULTI- AND MANYCORE SYSTEMS

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ABSTRACT

The hardware for challenging CFD simulations of today's and future applications is in the middle of a dramatic paradigm shift: Improvements of raw computational performance are no longer enabled by scaling CPU frequencies, but by increasing parallelism and heterogeneity. Typical modern laptops, tablet computers and especially workstations as the main workhorse of CFD practitioners contain many CPU cores, and quite often also some kind of accelerator device such as GPUs, or the recently introduced Xeon Phi. Researchers can no longer rely on "automatic speedups" enabled by advancements in compiler technology. Instead, this paradigm shift in the hardware results in a major challenge for the programming model, and techniques previously only relevant in High Performance Computing must be employed: The challenge lies in the fact that a lot of the existing sophisticated numerical methods (e.g., unstructured grids, adaptivity, higher-order methods, fully implicit schemes) are often not originally designed with hardware and computational performance in mind. Trading worse numerical efficiency for better hardware exploitation is not acceptable. Instead, novel methods must be devised that aim at maximising "total efficiency", i.e., O(N) methods for a given target accuracy that simultaneously achieve close-to-optimal numerical and computational efficiency, and that balance these often-conflicting goals.

The aim of this mini-symposium is to bring together practitioners in this challenging and modern research field, present advances in the area, and enable lively and fruitful exchange of ideas. We explicitly solicit contributions simultaneously addressing methodological and implementational aspects, including but not limited to emerging and established programming environments like OpenMP, CUDA, OpenCL, OpenACC, and techniques to program for performance.

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