

CEEC: Center of Excellence for Exascale CFD

Description

For many centuries, scientific discovery relied on performing experiments and the subsequent deduction of new theoretical models. The advent of powerful computers, coupled with new and ever more efficient numerical algorithms, makes it possible to simulate complex systems with increasing realism, and to automatize even model discovery using artificial intelligence (AI) technologies. Computational Fluid Dynamics (CFD) is one of the most prominent areas that clearly requires, and even motivates exascale computing to be part of the engineering and academic workflows. Given the physical scaling and the availability of highly efficient simulation codes, CFD has the potential to reach exascale performance, as one of the few application areas. This center will implement exascale ready workflows for addressing relevant challenges for future exascale systems, including those procured by EuroHPC. The significant improvement in energy efficiency will be facilitated through efficient exploitation of accelerated hardware architectures (GPUs) and novel adaptive mixed-precision calculations. Emphasis is furthermore given to new or improved algorithms that are needed to exploit upcoming exascale architectures. The efforts of the center are driven by a collection of five different lighthouse cases of physical and engineering interest, ranging from aeronautical to atmospheric flows, with the goal of reaching TRL 4 and even 5 for selected cases. All development is done in five European HPC codes which span the entire spectrum of CFD applications, including compressible, incompressible and multiphase flows.

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