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INTERDISCIPLINARY CHALLENGES TOWARDS EXASCALE FLUID DYNAMICS

TRACK 2000

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ABSTRACT

With Exascale computing capabilities on the horizon, we have seen a transition to more heterogeneous architectures for Computational Fluid Dynamics (CFD) applications. Traditional homogeneous scalar processing machines are replaced with heterogeneous machines that combine scalar processors with various accelerators, such as GPUs. While offering high theoretical peak performance and high memory bandwidth, to efficiently exploit these systems, complex programming models and significant programming investments are necessary. Furthermore, most known pre and exascale systems currently planned or installed, e.g. Frontier and LUMI, contain a large fraction of accelerators. Thus, the challenge of porting and tuning scientific codes for these new platforms can no longer be ignored.

CFD is a natural driver for exascale computing, with a virtually unbounded need for computational resources for accurate simulation of turbulent fluid flow, both for academic and engineering usage. However, established CFD codes build on years of verification and validation of their underlying numerical methods, potentially preventing a complete rewrite of a code base and rendering disruptive code changes a delicate task. Therefore, porting established codes to accelerators poses several interdisciplinary challenges, from formulating suitable numerical methods, performing hardware-specific tuning to applying sound software engineering practices to cope with disruptive code changes. The wide range of topics makes the exascale CFD transition relevant to a broader audience, extending outside the traditional fluid dynamics community.

This mini-symposium aims at bringing together the CFD community as a whole, from domain scientists to HPC experts, to discuss current and future challenges towards enabling exascale fluid dynamics simulations on anticipated accelerated systems.

REFERENCES

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