

High Performance Computing (HPC) in the Service of Aeronautics

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High Performance Computing (HPC) has become an integral part of NASA's Aeronautics research and application endeavors. HPC requirements for Aeronautics applications are increasing by leaps and bounds as scientists and engineers increase the fidelity of the simulations, the size of the engineering databases needed for NASA missions and develop new predictive capacities, such as for computational aero-acoustics, so as to include them in future aircraft and spacecraft design. In this talk, we focus on the challenges in efficiently exploiting exascale resources for Computational Fluid Dynamics (CFD) codes including parallel scalability at high concurrency, vectorization and memory access, along with fundamental algorithm improvements. We provide an overview of the resources available at the NASA Advanced Supercomputing (NAS) facility at Ames Research Center in Silicon Valley and describe how CFD applications have benefited from the use of supercomputing. We also examine the progress that has been made in optimizing CFD codes in order to efficiently exploit the characteristics of current and future HPC architectures including deep memory hierarchies and many-core processors.