GPU Acceleration of Multiphysics CFD Software for Propulsion and Power Flow Systems (RAPTOR)

Joseph C. Oefelein
Georgia Institute of Technology, Atlanta, GA

Ramanan Sankaran
Oak Ridge National Laboratory, Oak Ridge, TN

RAPTOR is a massively parallel flow solver designed to treat turbulent reacting flows in propulsion and power systems. These flows involve a multitude of strongly coupled fluid dynamic, thermodynamic, transport, chemical, multiphase, and heat transfer processes that are intrinsically coupled and must be considered simultaneously in the complex domains associated with e.g., gas-turbine and rocket engines. In preparation for the Summit system currently being installed at the Oak Ridge Leadership Computing Facility (OLCF), a performance portable and GPU ready version of RAPTOR has been developed. A combination of programming models has been used to convert the original distributed memory parallel code to a hybrid parallel code with multiple levels of parallelism. Major performance critical kernels have been reimplemented in C++ using the Kokkos programming model, and the main flow solver has been accelerated using OpenMP 4.5 compiler directives. This poster presents our approach, recent progress, and performance characteristics of RAPTOR under the OLCF Center for Accelerated Application Readiness (CAAR) program.

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