Efficient Discretizations for Exascale Applications

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Abstract

Efficient exploitation of exascale architectures requires rethinking of the numerical algorithms used in many large-scale applications. These architectures favor algorithms that expose ultra fine-grain parallelism and maximize the ratio of floating point operations to energy intensive data movement. One of the few viable approaches to achieve high efficiency in the area of PDE discretizations on unstructured grids is to use matrix-free/partially-assembled high-order finite element methods, since these methods can increase the accuracy and/or lower the computational time due to reduced data motion.

In this talk I will report on our work in the Center for Efficient Exascale Discretizations (CEED), a co-design center in the US Exascale Computing Project that is focused on the development of next-generation discretization software and algorithms to enable a wide range of finite element applications to run efficiently on future hardware. CEED is a research partnership involving 30+ computational scientists from two US national labs and five universities, including members of the Nek5000, MFEM, MAGMA, OCCA and PETSc projects.

Topics of discussion will include recent progress in CEED packages and applications, new miniapps, benchmarks and API libraries developed in the project, and our efforts in scalable unstructured adaptive mesh refinement, matrix-free linear solvers and high-order data analysis and visualization.

References

1. Center for Efficient Exascale Discretizations. . http://ceed.exascaleproject.org/.