Large-Scale Parallel Performance of Multigrid Preconditioned Multiphysics Simulations

Title of Funded Project: Enabling Predictive Extended MHD Simulations by the Development of Stable, Accurate and Scalable Computational Formulations and Solution Methods

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Abstract

This study evaluated the parallel scaling and performance of two multiphysics application codes for large-scale simulations. One application code simulates the drift-diffusion equations for semiconductor devices [1,2] while the other simulates resistive MHD [3]. A finite element method is used to discretize the system of PDEs on an unstructured mesh, then a fully-implicit Newton-Krylov solution method is employed. High fidelity solutions require the efficient and scalable solution of the large sparse linear systems. We considered the scaling of three different algebraic multigrid aggregation schemes for the drift-diffusion system [4], and found that the choice of aggregation scheme can have a significant impact on performance. Weak scaling studies for the drift-diffusion system have been performed up to 140,000 cores on both Blue Gene/P and Cray XE6 platforms. We have also examined scaling on a Cray XT3/4 platform.

References

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