Matrix Computations and Scientific Computing Seminar

Organizer: Jim Demmel and Ming Gu

Wednesday, 12:00–1:00 pm, 380 Soda Hall

Sep 23 **Per-Olof Persson**, UC Berkeley

Efficient Solvers for Sparse High-Order Discontinuous Galerkin Schemes

We present a number of efficient iterative solution techniques for two classes of high-order DG-FEM methods with high levels of sparsity. For the so-called Compact-DG method, we describe why standard black-box preconditioners typically perform poorly, and how they can be drastically improved by a combination of block incomplete factorizations, p-multigrid, and optimal orderings of the unknowns. We extend these results to a class of methods with line-based sparsity patterns, such as the Line-DG method, which gives between one and two orders of magnitude sparser linear systems. Special care is required to retain this sparsity in the preconditioning step, and some of the key components in achieving this are an SVD-based least square approximation by tensor products, and a matrix diagonalization technique for solving the resulting approximate system. We also show some real-world applications of our methods, including wind turbine simulations and optimal design of flapping wings.