Matrix Computations & Scientific Computing Seminar

Organizer: James Demmel & Ming Gu

Wednesday, 11:00am–12:00pm, 380 Soda

March 9 **Per-Olof Persson**, UC Berkeley

High-Order Discontinuous Galerkin Simulation of Flapping Wings Designed for Energetically Optimal Flight

The numerical simulation of flapping flight is a challenging problem, partly because of the large deformations of the computational domain, the transitional flows, and the complex geometries. We present our recent results with high-order accurate discontinuous Galerkin methods, which are capable of accurately solving complex flow problems on unstructured meshes. We generate tetrahedral meshes using the DistMesh mesh generator and the Delaunay refinement method. A nonlinear elasticity analogy is used both for curving the elements to align with the boundaries and for deforming the mesh due to the moving domains, which are modeled by a mapping-based high-order accurate Arbitrary Lagrangian-Eulerian formulation. The equations are discretized using the Compact DG method, and solved efficiently in parallel using Newton-Krylov solvers and optimized element ordering.

We demonstrate our solvers in the setting of a multi-fidelity framework for inverse design of flapping wings. A panel method-wake only energetics solver is used to define the energetically optimal wing shapes and flapping kinematics. Candidate designs are then simulated using our high-order solvers, to gain insight into practical wing designs, the influence of viscous effects, and when faster low-fidelity simulation tools can be sufficiently accurate.