Matrix Computations & Scientific Computing Seminar

Organizer: James Demmel & Ming Gu

Wednesday, 12:10–1:00pm, 380 Soda

April 25 **Shiv Chandrasekaran**, UCSB

A new technique for the numerical solution of partial differential equations

We present a new method, based on the minimization of certain Sobolev norms, for the numerical solution of partial differential equations. Our method has several interesting features. First, it is a very high-order method, even on complex curved geometries and variable-coefficient problems. Second, we prefer that the PDE is presented in first-order form. Finally, using exactly the **same** code (a few hundred lines of Matlab), we will demonstrate high-accuracy high-efficiency solution of the following types of 2D PDEs: `div-curl`, Poisson in 4×3 and 3×3 form, wave equation (1+1), heat equation (1+1), Helmholtz, elastic equation, bi-harmonic, linearized stationary Navier-Stokes, etc.. This is to be contrasted with traditional FEM and FD codes that must be specifically reformulated for each type of PDE, and even then exhibit only low-order convergence, especially on curved geometries. We present results on geometries that include the exterior of a polygonal car-shaped body, a domain with a slit, and domains with circular arcs on the boundary. Some of our solutions include singular functions that are also dis-continuous on a slit. A proof of convergence of the method will also be presented.