CRUNCH Seminars at Brown, Division of Applied Mathematics

Friday - September 3, 2021

High order finite element methods with extra smoothness

Charles Parker, Brown University

The first part of the talk will address conforming finite element methods for H^2 problems which arise engineering problems including plates and shells. Conforming approximation of such problems often requires C^1 continuity which, unfortunately, rules out the use of many, if not all, existing finite element codes. I will describe the details needed for the efficient implementation of arbitrarily high order finite elements with C^1 continuity on unstructured meshes of triangles exploiting properties of the Bernstein-Bézier polynomials. The issue of efficient preconditioning of the resulting systems is addressed. The method is illustrated by applying it to the solution of a number of representative test problems.
The second part of the talk will focus on pointwise divergence-free finite element methods for Stokes flow, which have received much attention recently. The stability of these methods affects the optimality of a priori error estimates and the performance of preconditioners. I will present a method which is uniformly stable in both the mesh size and polynomial order. In particular, the method possesses optimal convergence properties. I will then address the issue of preconditioning. The method is illustrated by applying it to the solution of a number of representative test problems.