Title: Stable cheapest nonconforming finite element methods for the Navier-Stokes equations

We will begin by a short review on the recent development in nonconforming finite elements on rectangular/quadrilateral/hexahedral domains. A nonconforming quadrilateral element for the biharmonic problem will be introduced, which generalizes the incomplete biquadratic element on rectangles, also the well-known Morley nonconforming element on triangular triangulations. The fourth-order biharmonic equation occurs in the modeling creeping flows and deflection of thin plates. A piecewise linear quadrilateral element is applied to approximate the velocity field of the Stokes equations with the piecewise constant element to approximate pressure field. We examine the discrete inf-sup condition for these elements. Finally, we introduce a stable cheapest finite element pair for solving the Stokes equations. We discuss the lowest cost and simplicity of the proposed method. The stable cheapest finite element method with a slight modification will be then applied to solve a driven cavity problem. Some numerical comparisons ensures the simplicity and superiority over other finite element methods. This talk is based on several pieces of joint works with Chunjae Park (Konkuk Univ.), Hyun Nam (Korea Institute of Atmospheric Prediction System), Sihwan Kim & Hyung Jun Choi (Samsung), Roktaek Lim & Jaeryun Yim (SNU).

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