A *P*-ADAPTIVE STABILIZED FINITE ELEMENT METHOD FOR FLUID DYNAMICS

By

Anil Kumar Karanam

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Examining Committee:

Kenneth E. Jansen, Thesis Adviser
Mark Shephard, Member
Jacob Fish, Member
Christopher D. Carothers, Member

Rensselaer Polytechnic Institute
Troy, New York

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ABSTRACT

Stabilized finite element methods have been shown to yield robust, accurate numerical solutions to both the compressible and incompressible Navier-Stokes equations for laminar and turbulent flows. This work presents an application of mesh entity based, hierarchical basis functions to a new stabilized finite element formulation, exploiting the capability to grade polynomial order while maintaining C^0 continuity while using traditional finite element data structures. The hierarchical basis accomplishes this by starting with vertex interpolants (a linear basis) and then allowing the polynomial order to vary on each entity (edges, faces, and regions) in the mesh which are then multiplied by blends within each element to build a composite function that is locally higher order but still globally continuous. Details of this formulation and its efficient implementation will be presented. Partition weighting schemes were developed to achieve optimal load balance and scalability for parallel simulations. An application is presented, of p-refinement applied to a laminar flow past a surface mounted unit cube placed in a channel. Finally, post-processing techniques are also described for the effective visualization of higher order solutions.