Finite element methods with discontinuous approximation

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Abstract

Finite element methods with discontinuous approximation have been active research areas in the past two decades. Discontinuous finite element methods include interior penalty discontinuous Galerkin (IPDG) method, local discontinuous Galerkin (LDG) method, hybridizable discontinuous Galerkin (HDG) method, weak Galerkin (WG) method, and conforming discontinuous Galerkin (CDG) method.

Finite element methods with discontinuous approximations use discontinuous P_k elements (P_k denotes a set of polynomials with degree k or less), while their continuous counterpart conforming finite element methods use continuous P_k element. Since discontinuous P_k element introduces many more degrees of freedom, one would expect higher order of convergence for the finite element methods with discontinuous approximation. However, discontinuous finite element methods have the same convergence rate as their continuous counterpart, i.e. $O(h^k)$ in an energy norm and $O(h^{k+1})$ in the L^2 norm. Can we develop discontinuous finite element methods, that can fully utilizes all the unknowns of discontinuous P_k element to achieve higher order of convergence than their continuous counterpart? This is the main the question that we like to answer in this talk.