Finite Element Methods for High Order Partial Differential Equations

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Abstract

After a brief discussion of the concept of consistent piecewise polynomial approximation to function in Sobolev spaces and its relationship with finite element methods for high order partial differential equations, I will present a universal construction of consistent nonconforming finite element spaces for 2m-th order elliptic boundary value problems in \( \mathbb{R}^n \) for any \( n \geq m \geq 1 \) and discuss various relevant issues including: both a priori and a posteriori error estimates, convergence and optimality for the corresponding adaptive finite element methods, comparisons between conforming, nonconforming, discontinuous Galerkin and finite volume methods, and the subtlety of breaking a higher order PDE into a system of lower order PDEs.