Hybrid High-Order Methods

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Hybrid High-Order methods have been introduced a couple of years ago by Di Pietro and Ern to approximate diffusion and linear elasticity problems. Since then, the development of HHO methods has received a vigorous interest, including in solids mechanics Biot's problem, nonlinear elasticity with small deformations, and hyperelasticity with finite deformations, and in fluid mechanics, the incompressible Stokes equations, the steady incompressible Navier–Stokes equations, and viscoplastic flows with yield stress. The discrete unknowns in HHO methods are face-based unknowns that are piecewise polynomials on the mesh skeleton. Cell-based unknowns are also introduced. These additional unknowns are instrumental for the stability and approximation properties of the method and can be locally eliminated by using static condensation. HHO methods offer several advantages:

1. the construction is dimension-independent;
2. general meshes (including fairly general polyhedral mesh cells and non-matching interfaces) are supported;
3. a local formulation using equilibrated fluxes is available;
4. computational benefits owing to the compact stencil and the higher-order convergence rates;
5. robustness in various practically important regimes (quasi-incompressible elasticity, advection-dominated transport).