Structure-preserving hybrid methods

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The classical finite element method uses piecewise-polynomial function spaces satisfying continuity and boundary conditions. Hybrid finite element methods, by contrast, drop these continuity and boundary conditions from the function spaces and instead enforce them weakly using Lagrange multipliers. The hybrid approach has several numerical and implementational advantages, which have been studied over the last few decades.

In this talk, we show how this hybrid framework has given new insight into a variety of structure-preserving methods for differential equations, including (multi)symplectic methods for Hamiltonian systems, charge-conserving methods for the Maxwell and Yang-Mills equations, and finite element exterior calculus. In particular, this provides a bridge linking geometric numerical integration of ODEs to numerical PDEs.