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Optimization-based, property preserving finite element methods

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We present an optimization-based approach for the accurate, property preserving finite element solution of Partial Differential Equations (PDEs) in which the solution is obtained by solving a suitably defined constrained optimization problem. The objective is to minimize the distance to a given finite element target, computed by a formally accurate but not necessarily property preserving scheme, while physical properties such as maximum principle and/or preservation of local solution bounds define the constraints. This divide-and-conquer strategy separates solution accuracy from the preservation of the relevant physical properties and always finds a globally optimal, with respect to the given target, solution that also satisfies these properties. To illustrate the approach we consider the finite element solution of a model scalar advection-diffusion equation and present some preliminary numerical studies. The talk will also examine connections between the optimization-based property preserving solution of PDEs and algebraic flux correction techniques for the preservation of local solution bounds.

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