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SCALABLE SOLUTION METHODS FOR ADVECTION DOMINATED PDEs USING AN OPTIMAL CONTROL REFORMULATION

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ABSTRACT

Efficient multilevel solution of linear systems arising in the discretization of advection–diffusion PDEs is still largely an open problem. This is especially true for algebraic multigrid techniques, where it is not clear what the best approach is to coarse–grid construction for problems that are nearly hyperbolic in nature.

In this talk we will discuss an approach motivated by classical operator split methods for advection–diffusion equations. These methods aim to improve solution efficiency by alternating between pure advection and pure diffusion solves, and can be viewed as resulting from an approximate factorization of the original operator into a product of diffusion and advection operators.

In contrast, our approach relies on optimization ideas to break down the solution of the advection–diffusion equation into the solution of a sequence of diffusion dominated problems, each of which can be efficiently handled by standard multilevel techniques. First, an additive operator split is applied to the original advection–diffusion problem. Second, the resulting equation is reformulated as a PDE–constrained optimization problem, which is solved in the null space of the constraint operator. Preliminary numerical results will be presented.