Preconditioning Saddle Point Problems from PDE-Constrained Optimization

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Advances in algorithms and hardware have enabled more research on the optimization of functions with constraints given by partial differential equations. Problems of this type arise in a variety of applications and pose significant challenges to optimization algorithms and numerical methods. The discretization of these problems typically leads to linear systems in saddle point form. Preconditioning of these linear systems is crucial in achieving fast convergence of the iterative schemes. For both preconditioners and the choice of the iterative method it is important to take the underlying structure of the matrix into account. We will illustrate this on examples from PDE-constrained optimization where both block-diagonal and block-triangular preconditioners can be used. The additional introduction of control constraints adds an extra layer of complexity and the bottleneck of the numerical methods to solve these problems is again the fast solution of the linear systems. We show that the techniques from the case without control-constraints carry over to this setup.

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