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Preconditioning of Full-Space Trust-Region SQP Algorithms for Nonlinear PDE Optimization

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We study a preconditioning technique designed for the scalable solution of linear systems arising in a full-space trust-region sequential quadratic programming (SQP) algorithm with applications to optimization problems governed by nonlinear partial differential equations (PDEs).

SQP methods are based on the successive minimization of a quadratic model of the Lagrangian functional subject to a linear Taylor approximation of the (PDE) constraints. While our full-space trust-region approach follows this algorithmic framework, the linear systems solved at each step of our algorithm are related to convex quadratic programs that involve only the linearized PDE constraints, i.e., are independent of the model of the Lagrangian functional. As a consequence, our approach extends the applicability of the recently studied optimal solvers for PDE-constrained optimization to a large range of optimal control, optimal design and inverse problems. We present numerical examples in fluid flow optimization, acoustic design and estimation of elasticity parameters.