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Multigrid methods for boundary control of elliptic equations

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The goal of this project is to devise efficient multigrid algorithms for the boundary control of elliptic equations. Using a reduced formulation, our focus is on designing optimal order multigrid preconditioners for the Hessian of the reduced cost functional. Ideally, the preconditioners should approximate the reduced Hessian with optimal order with respect to the discretization of the elliptic equation. We show that for Dirichlet boundary control of elliptic equations the preconditioner is of suboptimal quality, though still efficient. Instead, for Neumann boundary control, numerical results suggest the preconditioner to be of optimal order. This project is part of a larger research program on developing efficient solution methods for optimal control problems with PDE constraints.