Finite element error estimates on the boundary and its application to optimal control

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In this talk we consider a priori error estimates for an elliptic linear-quadratic Neumann boundary control problem with pointwise inequality constraints on the control. The domain is assumed to be polygonal and maybe non-convex. For discretizing the state linear finite elements are used, the control is approximated by piecewise constant ansatz functions. Approximations of the optimal control of the continuous problem are constructed in a postprocessing step by a projection of the discrete adjoint state into the set of admissible controls. For the proof of approximation rates for this optimal control problem, finite element error estimates in the L^2-norm on the boundary are essential, but it turned out that optimal ones are only available for domains with a maximum interior angle smaller than $\pi/2$. We prove that a convergence order close to 2 can also be obtained up to an interior angle of $2\pi/3$. For domains with larger interior angles we use mesh grading techniques to overcome the negative effects of corner singularities. We apply this result to the optimal control problem and show nearly second order convergence for the approximations of the solution. The theoretical results are illustrated by numerical examples.

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