

Exact penalization of pointwise constraints for optimal control problems

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Abstract

Optimal control problems for semilinear elliptic equations with pointwise control and state constraints are studied. Under a stability assumption of the optimal cost functional with respect to small perturbations of the set of feasible states, the existence of an exact penalization of the state constraints is well known. Also it is known that most problems are stable. Sufficient second order optimality conditions have been proved recently for these state-constrained control problems. We will prove that whenever the optimal control \bar{u} satisfies the first and second order sufficient optimality conditions, then the problem localized in a certain L^2 -ball around \bar{u} is stable. Therefore the sufficient optimality conditions imply the existence of an exact penalization of the state constraints. Finally, by using this fact we prove that \bar{u} is an element of the Sobolev space $H^1(\Omega)$, which improves the classical $W^{1,s}$ -regularity of \bar{u} , for $s < n/(n-1)$.

Key Words: Semilinear elliptic equations, pointwise state constraints, exact penalization, second order optimality conditions, regularity of optimal controls