Globalizing stabilized SQP by smooth primal-dual exact penalty function

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Abstract:

An iteration of the stabilized sequential quadratic programming method (sSQP) consists in solving a certain quadratic program in the primal-dual space, regularized in the dual variables. The advantage with respect to the classical sequential quadratic programming (SQP) is that no constraint qualifications are required for fast local convergence (i.e., the problem can be degenerate).

In particular, for equality-constrained problems the superlinear rate of convergence is guaranteed under the only assumption that the primal-dual starting point is close enough to a stationary point and a noncritical Lagrange multiplier pair (the latter being weaker than the second-order sufficient optimality condition).

However, unlike for SQP, designing natural globally convergent algorithms based on the sSQP idea proved quite a challenge and, currently, there are very few proposals in this direction. For equality-constrained problems, we suggest to use for the task the smooth two-parameter exact penalty function, which is the sum of the Lagrangian with squared penalizations of the violation of the constraints and of the violation of the Lagrangian stationarity with respect to primal variables.

Global convergence is established under natural assumptions. Moreover, we show that the globalized algorithm preserves the superlinear rate of sSQP under the weak conditions mentioned above.