A non-monotone filter exact penalty approach using inexact solutions of sequential quadratic programming problems for solving constrained nonlinear programming problems

Nezam Mahdavi-Amiri and Hani Ahmadzadeh
Sharif University of Technology
nezamm@sharif.edu

Sequential Quadratic Programming (SQP) algorithms for solving smooth constrained nonlinear programming (CNLP) problems have been popular for several decades, mainly due to their fast local convergence. These algorithms, however, having the engagement of all the constraints in every iteration, require high computational costs. Recently, non-monotone filter SQP algorithms have been introduced for solving large CNLP problems. Here, to speed up the iterations, we present a new version of such an algorithm, making use of inexact solutions of the SQP problems. The proposed method, making use of an exact penalty function, considers the use of two directions, the so-called steering and predictor directions. In a global iteration, with an infeasible iterate at hand, both directions are computed. The steering direction, computed as a minimizer of a linear approximation of the constraint violations over a trust region, is used to construct a convex feasible quadratic sub-problem for computing the predictor direction, which serves to be a descent direction for the penalty function. A combined steering and predictor direction is also specified to serve as a descent direction for the constraint violations. This direction is also made to be descent for the penalty function by a proper updating of the penalty parameter. In a local iteration, with a feasible iterate at hand, an inexact solution of a convex quadratic model is computed to serve as a descent direction for the objective function. To avoid the Maratos effect, a non-monotone filter strategy is employed in local iterations. A superlinear local rate of convergence is established under standard assumptions. Comparative numerical results obtained by an implementation of the proposed method on a collection of available test problems in the literature affirm the approach to be competitive.

Keywords: Constrained nonlinear programming, Sequential quadratic programming, Exact penalty function, Non-monotone algorithm, Filter strategy.