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A truncated Newton method for constrained optimization

Gianni Di Pillo (dipillo@dis.uniroma1.it)

Stefano Lucidi (lucidi@dis.uniroma1.it)

Laura Palagi (palagi@dis.uniroma1.it)

Università di Roma "La Sapienza" - Dipartimento di Informatica e Sistemistica - via Buonarroti, 12 - 00185 Roma, Italy.

Abstract

In this paper we consider the extension of the unconstrained truncated Newton method approach to the constrained optimization problem $\{minf(x) \ |g(x) \leq 0\}$. To this aim, we first consider a primal-dual system of nonlinear equations $F(x, \lambda) = 0$ with the property that $F(x, \lambda) = 0 \iff (x, \lambda)$ is a KKT *point* for the constrained problem. This system is derived on the basis of an efficient strategy for the identification of the constraints active at the solution. Then, we adopt a truncated Newton scheme for the solution of the system, based on a QR factorization of the gradient of the estimated active constraints and on conjugate gradient methods in the tangent space of these constraints. This approach is particularly advantageous when the number of variables is much larger than the number of constraints.

Under mild assumption and without requiring the strict complementarity, we prove local convergence with superlinear convergence rate of the iterates. Then, we show how to globalize the convergence of the iterates, making use of a line search technique applied to a primal-dual merit function in the class of exact augmented Lagrangian functions.

Preliminary numerical results are reported.

Keywords: constrained optimization, nonlinear programming, nonlinear programming algorithms, QR factorization, truncated Newton methods, augmented Lagrangian functions.

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