Two regularized primal-dual algorithms for nonlinear programming

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We present two regularized primal-dual algorithms for nonlinear programming. These algorithms are based on Newton-like methods applied to a perturbation of the optimality system that follows naturally from a reformulation of the initial problem using either a quadratic penalty function or an augmented Lagrangian function to handle equality constraints. The globalization is performed by applying a backtracking line search algorithm based on a primal-dual merit function. We detail the update rules of the different parameters in order to obtain good global convergence properties and a high rate of convergence. We also show that an advantage of this approach is to introduce a natural regularization of the linear system solved at each iteration to compute a search direction. This allows our algorithms to perform well when solving degenerate problems for which the Jacobian of constraints is rank deficient. Another important feature of these algorithms is that the penalty parameter is allowed to vary during the inner iterations, while it is usually kept constant. These methods have been implemented in the SPDOPT code. The good practical performances of this new solver have been demonstrated by comparing it to the reference codes IPOPT, ALGENCAN and LANCELOT.