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CP10

A Second-Order Optimality Condition with First- and Second-Order Complementarity Associated to Global Convergence of Algorithms

We develop a new notion of second-order complementarity with respect to the tangent subspace associated to second-order necessary optimality conditions by the introduction of so-called tangent multipliers. We prove that around a local minimizer, a second-order stationarity residual can be driven to zero while controlling the growth of Lagrange multipliers and tangent multipliers, which gives a new strong second-order optimality condition without constraint qualifications. We prove that second-order variants of augmented Lagrangian and interior point methods satisfy our optimality condition. Finally, we present a companion minimal constraint qualification, weaker than the ones known for second-order methods, that ensures usual global convergence results to a classical second-order stationary point.

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CP10

Some Convergence Properties of Regularization and Penalization Schemes for MPCCs

The mathematical programs with complementarity constraints (MPCCs) have been the subject of much recent research because of their theoretical and practical applications. From a nonlinear programming point of view, MPCCs are among the most highly degenerate problems, they violate at every feasible point the Mangasarian-Fromovitz constraint qualification which is a key ingredient for stability. As a consequence, most of the well developed theory for nonlinear programming cannot be applied directly to MPCCs. Another difficulty in dealing with MPCCs is their combinatorial nature due to the complementarity constraints, which implies that the optimality conditions for MPCCs are complex and not easy to verify. Therefore, developing an efficient algorithm for MPCCs is of a great interest. In this work, we propose an approach that combines a regularization scheme with a penalty method to solve the NLP reformulation of MPCCs. The relaxation scheme is to handle the lack of regularity of these problems and the penalty method is to penalize the equality nonlinear constraints and to update the relaxation parameter associated to the complementarity constraints. We investigate the convergence properties of this approach and we propose sufficient conditions to ensure that the cluster points of the sequence of stationary points generated by this approach are feasible for MPCCs.

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CP10

On Weak Conjugacy, Augmented Lagrangians and Duality in Nonconvex Optimization

The general duality theory for convex and nonconvex optimization problems, was comprehensively studied by Rockafellar and Wets. They used augmented Lagrangian functions in general forms and presented conditions for strong duality relations. The approach developed by Azimov and Kasimbeyli is based on a duality scheme, which uses the so-called weak conjugate functions. This conjugacy is constructed with respect to superlinear conic functions defined as an augmented norm term with a linear part added, instead of only linear functions used in convex analysis. A graph of such a function is a conical surface which serves as a supporting surface for a certain class of nonconvex sets. By using the mentioned class of superlinear functions, Azimov and Kasimbeyli introduced the concept of weak subdifferential – one of the natural generalizations of the classic subdifferential of the convex analysis and derived a collection of optimality conditions and duality relations for a wide class of nonconvex optimization problems. In this paper, we present the results obtained by both approaches. The duality results formulated in general forms, are similar in both approaches. We present duality results obtained for particular cases, that is for problems with equality and inequality constraints with illustrative examples.

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CP10

Mathematical Programms with Equilibrium Constraints: A Sequential Optimality Condition, New Constraint Qualifications and Algorithmic Consequences

Mathematical programs with equilibrium (or complementarity) constraints, MPECs for short, is a difficult class of constrained optimization problems. The feasible set has a very special structure and violates most of the standard constraint qualifications (CQs). Thus, the standard KKT conditionsare not necessary satisfied by minimizers and the convergence assumptions of many standard methods for solving constrained optimization problems are not fulfilled. This makes it necessary, both from a theoretical and numerical point of view, to consider suitable optimality conditions, tailored CQs, and specially designed algorithms for solving MPECs. In this paper, we present a new sequential optimality condition useful for the convergence analysis for several relaxation methods for solving MPECs. We also introduce a companion CQ for M-stationary that is weaker than the recently introduced MPEC relaxed constant positive linear dependence (MPEC-RCPLD). Relations between the old and new CQs as well as the algorith-