A linesearch derivative-free method for bilevel minimization problems

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Abstract

In this work we consider bilevel optimization problems which are programs with a particular nested structure. In such structure a problem, called lower lever or inner problem, is nested inside the feasible region of another problems, called upper lever or outer problem. When, for any fixed upper level choice, the lower level optimal solution is not uniquely determined then the outer minimization can be ill-defined. To address this pathology there are two main approaches: Optimistic and Pessimistic. In order to overcame this possible issue, we focused on bilevel programs with a supposed strictly convex lower level problem. In this framework we propose a new linesearch derivative-free resolution algorithm. Derivative Free (or Direct Search) methods do not required knowledge or calculation of derivative and for these reasons they are widely used to solve real world problems. The idea underlying this work is to use a Derivative Free Non-Smooth algorithm that, for each trial point which it explores, will compute the solution of the lower level problem. Roughly speaking, at each iteration of the algorithm an appropriate set of direction is explored in order to find a new point where the objective function value is sufficiently lower than the one assumed in the current optimal point. Under suitable assumptions it is possible to prove that an accumulation point of the sequence produced by the algorithm is a stationary point of the considered problem. With the aim to evaluate the performance of the proposed algorithm different numerical tests have been performed. The results of the preliminary numerical experience showing a possible practical interest in the proposed approach.

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