An Iterative Regularized Subgradient Algorithm with Information Delay for Solving Bilevel Convex Optimization Problems

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Abstract

This work focuses on the bilevel convex optimization problem. We introduce an iterative regularized subgradient algorithm to address this issue, allowing for the delayed utilization of subgradients for inner-level objective functions. With appropriate assumptions, we prove the convergence of the sequence generated by this method to the problem's solution and provide its convergence rate. Additionally, we leverage a similar incremental technique to propose a method for solving the bilevel convex optimization problem, particularly when the inner-level objective function comprises a finite sum of convex functions. Finally, we present numerical experiments on the image inpainting problem to illustrate the practical applications of our method. The results demonstrate that, despite requiring less time per iteration, the delayed subgradient method achieves comparable convergence to its non-delayed counterpart when delays are appropriately chosen.

Keywords: Delay, Bilevel optimization, Subgradient method