A Fast First-Order Optimization Approach to Quasistatic Elastoplastic Analysis with von Mises Yield Criterion

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ABSTRACT

Recently, the second-order programming (SOCP) has attracted much attention in computational plasticity. This paper presents a new algorithm for solving SOCP arising in the quasistatic elastoplastic analysis with the von Mises yield criterion.

The quasistatic incremental problem with the von Mises yield criterion can be reduced to the standard form of SOCP [2, 4]. It is known that an SOCP problem can be solved with a primal-dual interior-point method. However, conversion of the incremental problem to the standard form of SOCP requires many subsidiary variables and many additional constraints. This yields large computational cost for the standard SOCP solver. Instead of solving the standard form, in this paper we propose to solve an equivalent unconstrained nonsmooth convex optimization problem.

Accelerated first-order methods for convex optimization have received considerable attention, particularly for solving large-scale problems in image processing, regression, etc. Many of them have local first convergence property, due to the acceleration, and small computational cost per iteration, because they do not use the second-order differentials of the functions. In this paper, we adopt the accelerated proximal gradient method [1] with the adaptive restart scheme [3] to solve the elastoplastic incremental problem. Unlike other popular efficient methods in computational plasticity, the presented method does not use a linear-equations solver. This might possibly be an advantage from the viewpoint of computational cost, when the method is applied to large-scale problems. Preliminary numerical experiments suggest that the proposed method outperforms a standard implementation of an interior-point method that solves the standard form of SOCP.

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