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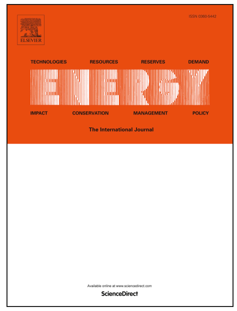

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Conic Relaxations of the Unit Commitment Problem

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Abstract

The unit commitment (UC) problem aims to find an optimal schedule of generating units subject to demand and operating constraints for an electricity grid. The majority of existing algorithms for the UC problem rely on solving a series of convex relaxations by means of branch-and-bound and cutting-planning methods. The objective of this paper is to obtain a convex model of polynomial size for practical instances of the UC problem. To this end, we develop a convex conic relaxation of the UC problem, referred to as a strengthened semidefinite program (SDP) relaxation. This approach is based on first deriving certain valid quadratic constraints and then relaxing them to linear matrix inequalities. These valid inequalities are obtained by the multiplication of the linear constraints of the UC problem, such as the flow constraints of two different lines. The performance of the proposed convex relaxation is evaluated on several hard instances of the UC problem. For most of the instances, globally optimal integer solutions are obtained by solving a single convex problem. For the cases where the strengthened SDP does not give rise to a global integer solution, we incorporate other valid inequalities. The major benefit of the proposed method compared to the existing techniques is threefold: (i) the proposed formulation is a single convex model with polynomial size and, hence, its global minimum can be found efficiently using well-established first-and second-

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