

# Assessing numerical performance of some nonsmooth optimization methods in solving thermal unit-commitment problems

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A large number of problems related to electrical power systems results in optimization models which are large-scale, non-linear, mixed-integer, and thus non-convex. Due to the presence of multiple coupling constraints, Lagrangian Relaxation appears as a natural approach for dealing with this kind of problems: it allows decomposing the problem into smaller and independent subproblems. Duality theory says that the resulting dual optimization problem gives lower bounds for the considered primal minimization problem. Moreover, solving the dual problem provides the best possible lower bound and a good starting point for primal recovering. Since the dual problem is convex but nonsmooth, specialized optimization algorithms need to come into play. Some suitable methods for this class of problems have already been developed, e.g. Subgradient, Cutting-Plane and Bundle methods. Algorithms in the bundle method family have two important advantages in comparison to the others: they are descent and stable, due to regularization of their master program that defines new iterates. Different regularization terms define distinct bundle methods. In this work, we are particularly interested in three different bundle variants: the classical Proximal Bundle Method, which employs regularization in the master's objective function; the Level Bundle Method, which regularizes the master's constraints; and the newly proposed Doubly Stabilized Bundle Method, which combines the proximal and level techniques. We assess the performance of the above three bundle variants in some classical nonsmooth optimization problems, and in a real-life Thermal Unit Commitment problem arising from the Brazilian power system. The latter problem is formulated as a mixed-binary linear program, and its dual problem has up to 7.700 variables.

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