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CADMM applied to Hybrid Network Decomposition

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Abstract
As system design problems increase in complexity, researchers seek approaches to optimize such problems by coordinating the optimizations of decomposed subproblems. The original problem may either be decomposed according to the involved disciplines or constitutive components. However, a mixed decomposition is obtained when a new discipline (component) is added to a problem decomposed by components (disciplines) to reflect the inherent dynamics within the design process. The resulting problem becomes a non-hierarchical, network optimization problem that requires a suitable Multi-Disciplinary Optimization (MDO) and Multi-Level Optimization (MLO) coordination approach. In this paper, two hybrid decompositions are used for a micro-accelerometer benchmark problem. In these hybrid problems, each subproblem is fully coupled with the other subproblems. Consensus optimization via Alternating Direction Method of Multipliers (CADMM) is proposed for modeling and solving the decomposed optimization problem. The numerical results error of CADMM is within 3% of the All-In-One reference solution, which indicates that the consensus mechanism in CADMM for dealing with coupling variables performs well on the hybrid network problem. This is, to our knowledge, the first application of CADMM to hybrid decompositions in which subproblems represent disciplines and/or components.

Keywords: Network problem; Consensus optimization; Micro-accelerometer problem; Hybrid decomposition