MODELING HIERARCHICAL SYSTEMS VIA NESTED GENERALIZED DISJUNCTIVE PROGRAMMING

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Abstract

Modeling systems with discrete-continuous decisions is traditionally done in algebraic form with mixed-integer programming models, which can be linear or nonlinear in the continuous variables. A more systematic approach to modeling such systems is to use Generalized Disjunctive Programming (GDP), which extends the Disjunctive Programming paradigm proposed by Egon Balas. GDP allows modeling systems from a logic-based level of abstraction that captures the fundamental rules governing such systems via algebraic constraints and logic. Although GDP provides a more general way of modeling systems, it warrants further generalization for systems presenting a hierarchical structure. This work extends the GDP literature to address alternatives for modeling and solving systems with nested (hierarchical) disjunctions. We also provide theoretical proofs on the relaxation tightness of such alternatives, showing that explicitly modeling nested disjunctions is superior to the traditional approach discussed in literature for dealing with nested disjunctions.

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