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Solving a Class of Bilevel Programming Problems by DC Programming and DCA

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Abstract: In this paper, we propose an optimization model to address a specific class of bilevel programming problems. We transform the bilevel problem into a single-level optimization problem using the optimal value function reformulation. Since the lower-level problem is non-convex, we rewrite the value function of the lower-level problem as a Difference of Convex Functions (DC). To achieve this, we employ a regularization approach in the value function of the lower-level problem, which enables us to formulate the problem as a DC program. The resulting problem is then solved using the DC algorithm (DCA). The efficiency of the proposed algorithm is demonstrated through the results obtained from our computational analysis.

Keywords: *bilevel programming; DC optimization; penalty function; regularization approach.*

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1 Introduction

Bilevel optimization is a key area of mathematical programming that is crucial for solving hierarchical decision-making problems. In nonlinear dynamical systems, it enhances control, responsiveness, and stability. For example, a nonlinear control model can represent the interaction between an upper-level controller that optimizes stability and a lower-level controller that executes decisions based on system dynamics. This framework is valuable in robotic control, smart grids, and energy management because it balances competing objectives under dynamic constraints [8]. Additionally, discrete event simulation (DES) and system dynamics (SD) have been used to analyze waiting times and queue lengths in healthcare systems such as outpatient departments (OPDs) [3]. While

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