A Combined DC-programming Hybrid Approach for the Single-Vehicle Inventory Routing Problem

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I. INTRODUCTION

The single-vehicle cyclic inventory routing problem (SV-CIRP) is concerned with a repeated distribution of a product from a single depot to a selected subset of retailers having stable demands. The objective is to determine the subset of retailers to cyclically replenish, the quantities to be delivered to each, and to design the vehicle routes so that the expected total distribution and inventory cost is minimized and the total collected rewards are maximized while preventing stockouts from occurring at each selected retailer.

II. PROBLEM FORMULATION AND SOLUTION STRATEGY

The SV-CIRP arises naturally as a sub-problem, when a column generation based approach is used to solve the general cyclic inventory routing problem (CIRP) (see [1]). The SV-CIRP is formulated as a mixed-integer program with linear constraints and a nonlinear objective function in this work (see e.g. [2] and [3]). In [1], the authors presented some novel concepts of vehicle ‘multi-tour’ and ‘cycle time’. These concepts play a very important role in the problem formulation. More details of these concepts we refer to in [1].

In [2], an in-depth analysis of the SV-CIRP was carried out and a steepest descent hybrid algorithm (SDHA) was proposed to solve the problem to global optimality. However this approach requires a large amount of computational time due to the fact that it involves the solutions of many mixed-integer linear programs (MILPs). Afterwards, a DC-programming approach combined with Branch-and-Bound was proposed to solve the SV-CIRP with a fixed cycle time in [3]. As a consequence, this method is then extended in this work: a global optimization approach integrating DC-programming and the SDHA (denoted by DCA-SDHA) is proposed to solve the complete SV-CIRP to optimality.

III. CONCLUSIONS

The proposed DCA-SDHA is tested on some randomly generated problems. The current numerical results show that it can indeed make the solution procedure run faster. These encouraging results instill a reasonable hope for solving the SV-CIRP, especially for large-scale instances in a more efficient way.

REFERENCES