An efficient algorithm for the Cyclic Inventory Routing Problem subproblem

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Abstract

The Single-Vehicle Cyclic Inventory Routing Problem (SVCIRP) is an optimization problem that provides a cyclic logistical plan, which maximizes the collected rewards while minimizing transportation and inventory costs, for the distribution of a product to a selected subset of retailers using one vehicle. It appears as a fundamental building block when column generation based methods are used to solve the cyclic inventory routing problem (CIRP). The current formulations for this problem all use a non-convex objective function. The presence of this non-convex objective function is a main complication in solving the SVCIRP efficiently, which in turn hinders the development of efficient solution methods for the CIRP. We examined the structure and mathematical properties of the SVCIRP and reformulated the problem so that its continuous relaxation is a convex problem. We proposed an adjusted branch-and-bound algorithm that solves the SVCIRP efficiently. Compared to the benchmark instances for this problem we were able to find new 23 out of 50 new best solutions and proved optimality of 22 other instances.

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