A Column Generation Framework for Industrial Gas Inventory Routing

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Abstract

In this work we propose a column generation approach for solving the Inventory Routing Problem with Replenishment Facilities (IRPRF). The IRP concerns the distribution of industrial gases from a set of production plants to a set of customers under Vendor Managed Inventory (VMI) distribution policy. Industrial gases are stored at the production plants. The supplier knows the future demand such that no product run-out is allowed.
We consider a multi-period IRP problem with a discrete short-term planning horizon. The considered IRP is a multi-product problem with a heterogeneous fleet of capacitated vehicles, and time windows for customers and production plants. The problem also includes a rich set of business constraints.

Two versions of the IRP problem are considered in this work. The first version minimizes the total distribution cost. The second version minimizes the logistic ratio (the ratio between the total distribution cost and the total delivered quantity). To the best of our knowledge, very few papers deal with the non-linear (rational) objective function.
We propose a unified column generation approach that can solve both versions of the problem. To deal with non linear objective function, we introduce a suitable variables substitution, which leads to a linear formulation that can be used for computing valid lower bound for the problem. The paper provides computational results concerning heuristics and valid dual bounds for the problem, based on real on the field instances.

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