AN EFFICIENT COLUMN GENERATION ALGORITHM
USING INTERIOR POINT METHODS

The column generation technique has been successfully applied in the solution of integer programming problems, in particular to improve the performance of branch-and-bound strategies. In this context, the column generation technique is used to solve linear programming problems that usually arise from the relaxation of a reformulated integer programming model.

The classical column generation technique is well-known for its unstable behavior that results in a large number of iterations. The main reason for that is the oscillation of the optimal dual solutions used to generate new columns at each iteration. To overcome this behavior, variations of the classical algorithm rely on interior points of the dual feasible set, instead of using extremal dual solutions.

In this paper, we address the primal-dual column generation technique, which relies on well-centered primal-dual feasible solutions obtained by a primal-dual interior point method. We summarize the main theoretical issues involved in this technique and present computational experiments for three classical combinatorial optimization problems: the cutting stock problem, the vehicle routing problem with time windows, and the capacitated lot sizing problem with setup times. The results show that the primal-dual column generation technique leads to substantial reductions in the number of iterations and CPU time when compared to two other well-established approaches: the classical column generation technique and the analytic center cutting plane method. Moreover, the larger the instance the better was the relative performance of the primal-dual approach.

Keywords: column generation, interior point methods, integer programming.