

A Column Generation Approach for Solving the Fixed Route Dial-A-Ride Problem

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Abstract. The fixed route dial-a-ride problem (FRDARP) is a demand-responsive transport solution in which passengers request to be transported at certain times between destinations that are located along a fixed route. The aim is to operate all the requests with a given fleet of vehicles and a bounded number of transports in a manner that minimizes the passengers' overall deviation from the requested times. The FRDARP is a variant of the famous dial-a-ride problem (DARP), in which the difficulty of finding the vehicle routes is neutralized by determining the route in advance. With a fixed route, the remaining problem is of grouping customers together and scheduling the timetable. The DARP solutions, and in particular the FRDARP, are suitable for a variety of transportation needs, including dedicated solutions for low-populated areas, as well as for customers with special needs, such as children or elderly.

Recently, we have presented a polynomial algorithm to solve the FRDARP by a reduction to the shortest path problem. Based on the problem input, we dynamically construct a graph; a shortest weighted path in this graph, which starts at a source node and ends at a goal node, corresponds to an optimal schedule. Though the presented method for solving the FRDARP is polynomial, its implementation involves construction and traversal of huge graphs. Therefore, finding an optimal solution for a large number of requests becomes a non-trivial challenge. FRDARP can be also modeled as an integer linear programming, yet with a huge number of variables. Here, we present a column generation approach for solving FRDARP using an integer linear programming formulation. We show that the sub-problem that defines the entering variable at each iteration is a coloring problem of an interval graph, which is polynomially solvable. By using column generation, we expect to appreciably reduce the running time needed for finding an optimal solution and therefore increase the applicability of FRDARP for large problems.

Keywords: Demand Responsive Transport · Dial-a-Ride Problem · Fixed Route · Column Generation.