Route Generation For Warehouse Management Using Fast Heuristics

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In this research, fast heuristics for a centralized multi-agent route planner are presented and computationally evaluated. We solve a sub-problem of warehouse scheduling involving the routing of intelligent agents as a preliminary step in optimizing the total schedule. The problem involves the generation of routes for automated agents tasked with the transfer of items within a warehouse from storage pallets to a common loading shed. The goal is to minimize the total distance of the routes and the number of routes generated. This constitutes a multiple-objective optimization problem which is NP-hard and hence can take a prohibitively long time to solve using existing search-based techniques. The approach adapted here is to model the system as a Split-Delivery Vehicle Routing Problem (SDVRP) with grid distances and to solve it using heuristics based on tested operations research concepts. Twenty-two such heuristics are tested including the well-known greedy Nearest-Neighbor (NN) heuristic, and the established Savings heuristic of Clarke and Wright. Two SDVRP variations of the NN algorithm are introduced, namely the Nearest-Fill (NF) and Nearest-Fill Farthest-Start (NFFS) heuristics. Existing SDVRP improvement procedures are also considered and generalized to produce numerous heuristic variations. This novel approach of applying fast vehicle routing heuristics to multi-agent routing has the advantage of yielding good quality results within a very short period of time. The results of the study show that the greedy NFFS heuristic combined with the improvement procedures, consistently produces superior results with regard to minimization of distance and the number of routes in all the instances tested.

Figure 1 shows the routes generated for a benchmark SDVRP instance by one of the algorithms.

Keywords: multiple-agents, route generation, routing, warehouse automation, heuristics, planning, planner

References

1) Jose Ildefonso U. Rubrico, Jun Ota, Toshimitsu Higashi, Hirofumi Tamura, Masataka Akiyoshi: “Route Generation For Warehouse Management Using Fast Heuristics”, IROS 2004. Submitted.

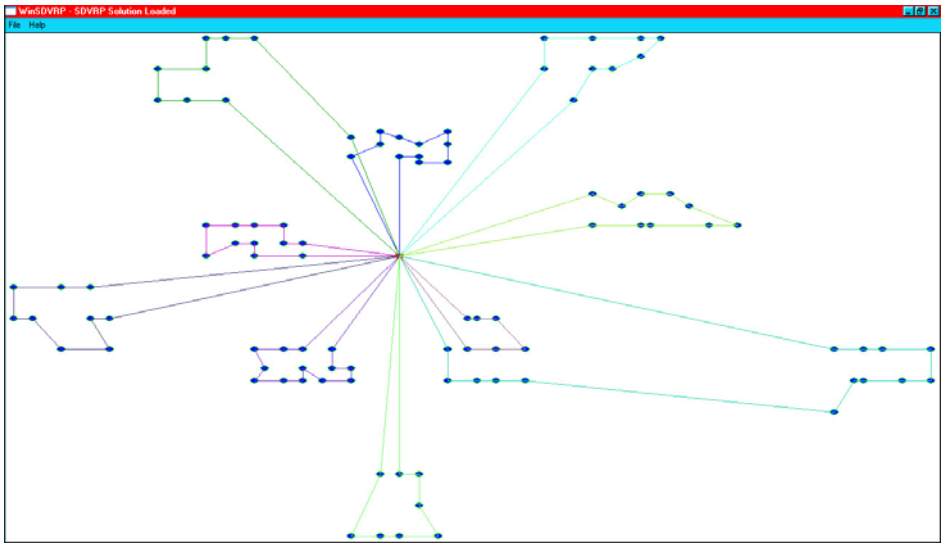

Figure 1. Generated routes on a benchmark instance using the DTH3 algorithm