Title: Dynamic allocation and resource planning in the management of a bus terminal

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Abstract:

The assignment of buses arriving to available gates is a major issue during the daily operations in a bus station. Such a problem is known in literature as Gate Assignment Problem and consists, given the daily bus schedule, in determining the best feasible assignment of the buses to the gates based on certain preference criteria. In order for a solution to be feasible at least two constraints have to be satisfied: each bus must be assigned to one and only one platform and two buses whose time intervals of platform occupation overlap cannot be assigned to the same platform.

Problems similar to gate assignment in bus stations arise in the management of airports, train stations, ports, freight villages and so on. There are also strong similarities with the register assignment problem in Digital Signal Processors. In the bus station case, manager may require that the bus-platform assignment plan occupies the minimum number of platforms during the planning horizon. For this problem we propose a novel formulation as a list-colouring problem of an interval graph and an integer linear programming model to solve it.

Trip delays such as early or late arrivals and late departures are a frequent occurrence in actual day to day bus station operations and it is often not possible to assign such buses to their original platforms. For this reason we considered a mathematical programming model to increase the robustness of the solutions by the minimization of the probability that buses assigned to the same gate may be "in conflict".

Finally, in order to generate a good solution in a reasonable computation time, we also propose a heuristic algorithm, based on the idea to solve the problem by dividing it into smaller sub-problems, using a receding horizon control, and then reconstructing the complete solution.

Computational experiments on a real bus station with 24 platform and more than 200 bus trips have been performed showing the effectiveness of the approach.

Keywords:

Bus station management, Gate assignment, List colouring, Interval graphs, Heuristic methods