Heuristic approach for the driver scheduling problem

Viktor Árgilán, János Balogh, József Békési, Balázs Dávid, Miklós Krész

A central problem of public transportation companies is to optimize their operational process. Since the minimization of the overall operational cost is a very complex task, the arising subproblems are considered as separeted optimization problems. Vehicle scheduling assigns the trips of the input to vehicles that execute them, while driver scheduling creates the daily duties of the drivers based on the vehicle schedules.

In this presentation, we introduce a heuristic for the driver scheduling problem. Both vehicle- and driver scheduling are NP hard [2, 3]. An exact solution for our problem can be found in [1], where the problem is presented as a set-covering problem, and is solved by column generation. Using this approach, optimal solution for a real-life instance of a middle-sized city (approximately 5000 trips) can take up to several weeks, as the number of possible driver duty combinations generated by the pricing problem is too large. This way, the method cannot be applied in practice, so we developed a heuristic to speed up the generation process. The method partitions the trips of the input into two sets based on their starting time. Trips starting "too late" are selected, and the driver scheduling problem is solved using these as an input. Suitable driver schedules of the solution are saved, while trips of the other schedules are joined with the remaining partition. Trips of this resulting partition are divided using time windows, and the problem is solved for each individual time window separately in a sequential manner. Each resulting schedule of a phase is considered as a single trip in the future, and joined with trips belonging to the next time window. With the decrease of the number of trips, this approach decreases the size of our problem significantly, and allows the exact method to solve the smaller sub-problems in an acceptable running time.

Our new heuristic approach has been tested on real-life input. The test results show that running time significantly decreases, while the cost of the solutions remains close to the optimum.

Acknowledgements

This work was partially supported by the European Union and co-funded by the European Social Fund through project HPC (grant no.: TÁMOP-4.2.2.C-11/1/KONV-2012-0010).

References

[1] Balogh, J., Békési, J. Driver scheduling for vehicle schedules using a set covering approach: a case study. *Proceedings of the 10th International Conference on Applied Informatics*, Accepted, 2014.

[2] Bertossi, A.A., Carraresi, P., Gallo, G. On Some Matching Problems Arising in Vehicle Scheduling Models. *Networks* 17, pages 271-281, 1987.

[3] Fischetti, M., Lodi, A., Martello, S., Toth, P. The fixed job schedule problem with working-times constraint. *Operations Research* 37, pages 395-403, 1989.