optimising railways

SMA and partners Ltd

Gubelstrasse 28
8050 Zurich
Switzerland
Phone +41 44 317 50 60
info@sma-partner.com
www.sma-partner.com

A further step towards automated conflict resolution for MoD: Changing the microscopic routing

In our previous articles Automatic conflict resolution using MoD services and Microscopic conflict visualisation and resolution using co-pilot support, we reported on research work, partially conducted with universities, on a prototype for automated microscopic conflict resolution.

The starting point of this process is a timetable concept planned in Viriato. In order to check this microscopically as part of DB InfraGO AG's medium-term concept for optimised capacity utilisation (mKoK), microscopic services were used to determine any remaining conflicts. Until now these have had to be resolved manually, for example by adjusting running and stop time reserves and by making changes to routes in stations in the timetable concept. Since an updated microscopic conflict check is still required after modifying the timetable concept, which in turn can lead to further changes, several iterations of this manual procedure may be necessary - a tedious and time-consuming task for the timetable designer.

Although the planning of the timetable concept in Viriato coupled with microscopy integration via MoD already has considerable efficiency advantages over pure microscopic planning, further gains in the number of conflict resolution iterations are highly desirable. In a next step, our approach aims to leave the creative work to the planner while relieving them of the tasks that can be automated. In particular, we emphasise the importance of being able to understand the results of the automation while retaining the general structure of the timetable concept: Adjustments to the timetable will only be made where necessary to resolve conflicts and the sequence of trains and commercial stopping times will be kept.

In what is now a number of projects, we have achieved some very promising results towards this goal in collaboration with various research institutes. Our latest collaboration, in this case with the TU Dresden has resulted in a diploma thesis that led to an algorithm that can now make route changes to trains in addition to the automatic adjustment of stopping time and running time reserves. As in practice the calculation effort for route changes increases significantly due to the increasing complexity of the problem, the use of an advanced mathematical optimisation technique (‘column generation’) has become necessary. Results from current research [1] by Prof Dr Karl Nachtigall and M.Sc. Maik Schälicke were applied to this problem.

The results achieved in the work to date will now be tested for their suitability for everyday use, and be developed further as part of an improved implementation in future consultancy projects in order to meet the challenges that arise in real-life planning. In a first use case for a major German railway infrastructure manager, trains are rescheduled to other corridors due to the closure of a route, with the choice of rerouting initially being made manually. The rerouted trains are thus additional train paths that are inserted on other corridors, which are then microscopically de-conflicted by the automation system.

We would like to thank the supervisors involved, Prof Dr Karl Nachtigall and M.Sc. Maik Schälicke, for their excellent collaboration on the thesis and look forward to further interesting projects with our research partners!

Congratulations to Jonathan Gut and we are delighted that he is now part of the SMA team!

[1] Schalicke, M., Nachtigall, K. (2024). Solving the Real-Time Train Dispatching Problem by Column Generation arXiv preprint arXiv:2306.13431v2