Optimisation of operations in public transportation

Federico Farina, PhD project

Relevance – challenges, problem or opportunity?

The PhD project is part of the larger IPTOP project concerning integrated public transport optimisation and planning. Traditional planning of public transport can be seen as a five step planning process: infrastructure planning, line and frequency planning, timetabling, rolling stock scheduling and crew scheduling. This project will deal with the integration of timetabling and rolling stock planning, the integration of these two planning phases potentially lead to a better overall usage of the available train equipment, reduce the operational costs and allow a faster planning phase.

Research question?

- Is the integration of train Timetabling and Rolling stock planning feasible and what level of performance can be achieved.

Conceptual model/theory

Timetabling planning constructs an actual time table based on the line decisions taken previously. Afterwards *Rolling stock planning* decides which train units should serve each line on a specific day using the timetable previously created as input. These two problems have been studied and are carried out as separated optimisation problems but, given the interrelations of the two phases, in reality multiple iterations might be necessary to find solutions and the found solutions may be sub-optimal. Therefore the integrated approach has potential of finding better solutions.

Method

The integration of the two planning problems will be studied and implemented first as a loosely coupled approach where two separated tools will be used to solve the problems and the results will be used as feedback for multiple automatic iterations. Afterwards a full integration will be modeled and implemented. Solution methods that are based on branch-and-bound algorithms (branch-and-price, branch-and-cut, etc.) will be taken into account but also because of the complexity of the integrated problem meta-heuristic approaches will be considered (i.e. Tabu Search, Simulated Annealing, Large Neighbourhood Search an others).

Expected results

A prototype tool for automated timetabling for intercity and regional trains is expected. The tool will be able to produce several timetables based on different optimization criteria in a relative short amount of time. The incorporation of rolling stock rotation in the time tabling process allows us to construct timetables that will be better from a rolling stock perspective. This can lead to increased robustness and cheaper operations and allows us to have a better usage of the available resources while at the same time being as robust as the current timetable.

Contact:
Federico Farina, PhD student
Produktionstorvet, building 426
DK-2800 Kgs. Lyngby
+ 45 61 35 31 77
fefar@dtu.dk
www.man.dtu.dk

Supervisor/co-supervisor:
Stefan Røpke
Allan Larsen
Evelien van der Hurk
Roberto Roberti

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banedanmark

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