



Thesis project:

Solving large-scale periodic time-tabling problems for Germany

Description

Timetabling is one of the most crucial and complex problems in railway planning. With the continuous growth in rail transport demand and the constraints of limited infrastructure capacity, railway systems are under significant pressure to enhance efficiency and service quality. In Germany, the challenge of designing efficient, robust, and integrated railway timetables has become even more significant with the implementation of the Deutschlandtakt — a nationwide project aiming to create a regular, harmonized, and synchronized timetable across the entire country.

The Deutschlandtakt, German integrated regular interval timetable, is designed to improve connections, reduce waiting times, and increase the attractiveness of rail services. Achieving this requires the systematic synchronization of thousands of trains operating at regular intervals, which massively increases the complexity of the timetabling process.

Mathematical models and optimization techniques play a critical role in supporting the design of such large-scale, integrated timetables. They allow planners to optimize train paths, minimize conflicts, maximize network utilization, and ensure robust and resilient operations even under highly saturated network conditions. However, existing planning systems often struggle with the scale and complexity introduced by initiatives like the Deutschlandtakt.

Assignment

This thesis proposes to explore and develop optimization methods for solving large-scale periodic timetabling problems within the framework of the Deutschlandtakt. Emphasis will be placed on leveraging modern mathematical programming, decomposition techniques, and/or heuristic approaches to manage problem size, ensure feasibility, and improve solution quality.

Expected research steps are:

- Literature study of existing articles
- Data preparation
- Develop a new approach for designing periodic timetables
- Experimental study
- Write a report

Background

The student should have a strong background in transportation science, preferably rail operations and scheduling. A solid understanding of have knowledge and interest in mathematical optimization, data analysis, and programming is welcome. The research topic can be suitable as research work (Studienarbeit), MSc thesis project or a diploma.

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