TECHNISCHE UNIVERSITÄT DRESDEN

PROFESSUR FÜR BETRIEB VON BAHNSYSTEMEN

Fakultät Verkehrswissenschaften | Chair of Railway Operations

Diplomarbeit / Masterarbeit: How Public Transport Network and Timetable Design Affect Passenger Flow and Service Performance: A MATSim Study

Problem description

Public transport line planning and timetable scheduling are typically studied from an operational optimization perspective. However, how these planning decisions reshape travel demand distribution and influence overall service performance in transport networks remains insufficiently understood. Changes in public transport routes, connectivity, or service frequency can redistribute passenger flows not only within public transport, but also across competing modes, e.g., car and bike, affecting modal split, network load, and travel times. Agent-based simulation provides a powerful framework to investigate these complex interactions. Using MATSim, large-scale multimodal systems can be modeled with dynamic interactions between transport supply and travel demand.

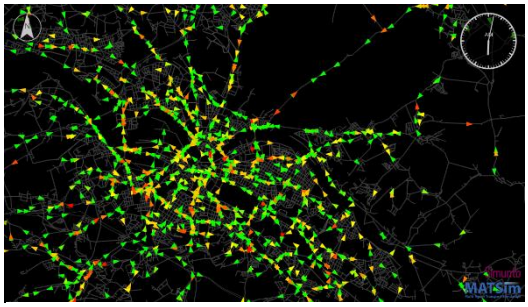

Figure 1: MATSim Dresden scenario (https://github.com/matsim-scenarios/matsim-oberlausitz-dresden)

This project aims to investigate how different public transport line planning and timetables influence passenger flow distribution and service performance in a multimodal context. The study will be based on the existing Dresden MATSim scenario. By systematically modifying public transport network structures and timetable configurations, the research will generate multiple scenarios and compare their simulation outcomes. For example, the network structure may change when a major disruption occurs (e.g., the collapse of the Carola Bridge requiring tram or bus routes to be rerouted), when a new tram line is introduced, or when construction works force temporary detours in the bus network. Timetable configurations may also be adjusted, for instance by changing departure frequencies, shifting departure times, or coordinating connections after routes have been modified. The results will be analyzed to quantify the impact of public transport planning and operations on network-level service performance and passenger flow patterns.

Assignment

- Design scenarios with different network structural and timetable configurations
- Use the existing Dresden MATSim scenario as the simulation base, implement the scenarios in MATSim and run simulations
- Extract system-level indicators, such as travel time, modal split and congestion levels
- Apply statistical methods to evaluate the relationship between planning strategies and system performance
- Write a structured report or thesis

Background

Students undertaking this project are expected to have basic programming skills (e.g., Java or Python) and solid data analysis capabilities. Familiarity with agent-based simulation, especially experience with MATSim, is highly beneficial but not strictly required. Prior knowledge of public transport planning, including line planning and timetable scheduling, will be advantageous for designing meaningful scenarios and interpreting simulation results. This topic is suitable for a student work, diploma and MSc thesis.

Reference

Meinhardt, S., Rakow, C., Heinrich, P., & Nagel, K. (2026). The MATSim Open Dresden Scenario (1.0.2). Zenodo.

Narayan, J., Cats, O., van Oort, N., & Hoogendoorn, S. (2017). Performance assessment of fixed and flexible public transport in a multi agent simulation framework. *Transportation Research Procedia*, 27, 109-116.

Narayan, J., Cats, O., van Oort, N., & Hoogendoorn, S. (2020). Integrated route choice and assignment model for fixed and flexible pu
blic transport systems. *Transportation Research Part C: Emerging Technologies*, 115, 102631.

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