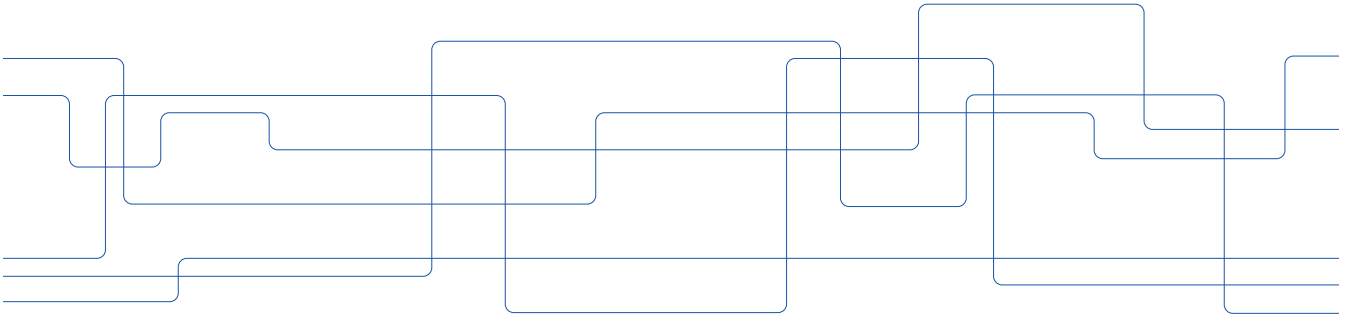




Evaluating crowding in individual cars of multi-car vehicles

Melina Pefitsi





Overview - Objectives

- Public transport system is confronted with overcrowding
- Many negative effects: Discomfort, longer dwell times, denied boarding
- Passenger loads can be highly unevenly distributed among cars even in peak hours

Objectives

- Utilize metro car load data to *quantify the train crowding unevenness and evaluate the performance of the metro system*
- *Develop a quantitative method for evaluating crowding of multi-car vehicles in a more realistic way, considering uneven passenger distribution.*



Train crowding unevenness

Train crowding unevenness metric

- Measures how far the passenger distribution deviates from a totally equal distribution
- Captures the crowding experienced by each passenger
- Takes values between 0 and 1

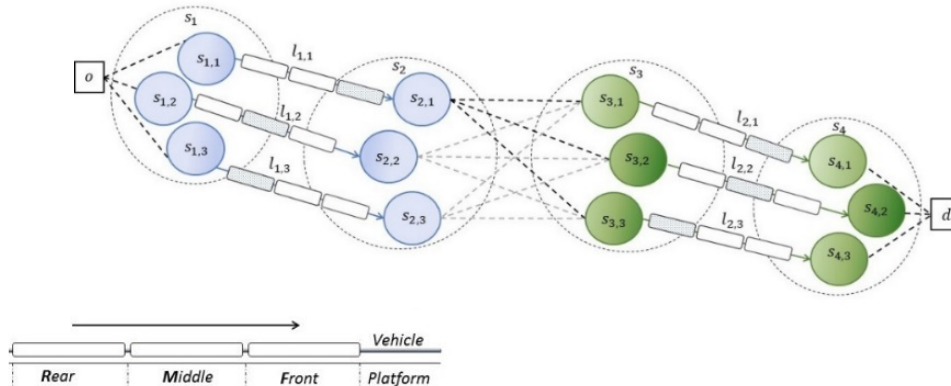
$$G_{\beta(q)} = \frac{1}{2n \bar{\beta} Q} \sum_i \sum_j |q_i \cdot \beta(q_i) - q_j \cdot \beta(q_j)|$$

Path choice modelling approach

- Passengers make a sequence of travel decisions, i.e. boarding, alighting and walking decisions, based on their expectations

Car choice is affected by:

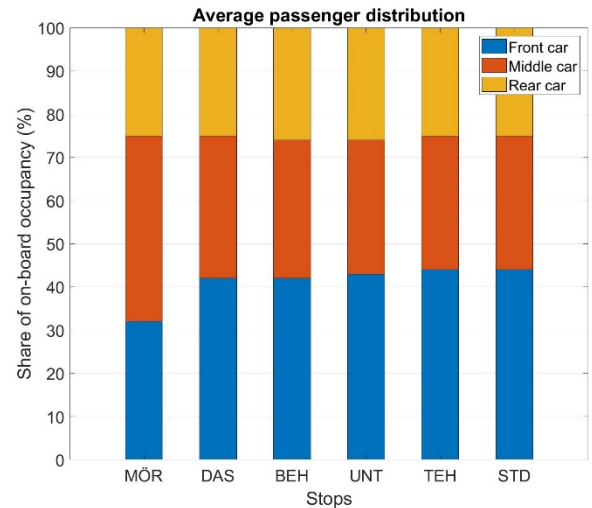
- Walking time from the origin location to the first connected platform section
- On-board crowding when passengers have prior experience about service attributes



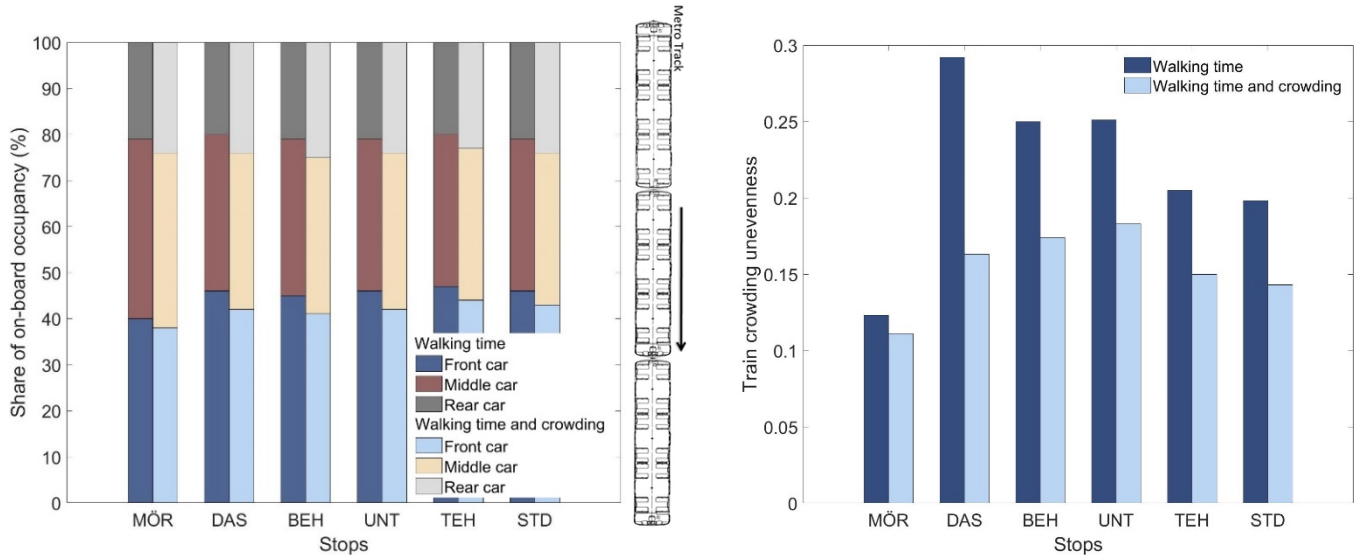
Study area



- Southbound train trips from MÖR towards STD
- Highly skewed passenger distribution among cars



On-board crowding experience



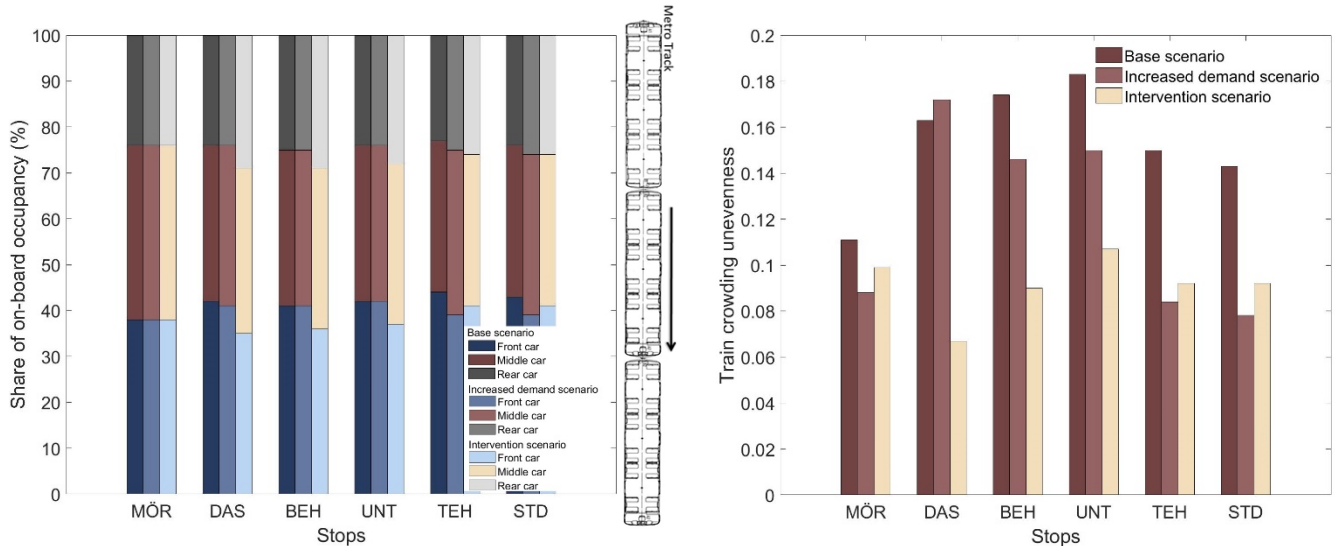
- More uniform on-board passenger distribution when considering crowding impact on passenger's decision



Scenarios design

- *Base scenario*, where the studied area is simulated with the current average morning peak hour demand.
- *Increased demand scenario*, where the studied area is simulated with increased demand by 20%.
- *Intervention scenario*, where an operational change is considered at Danderyds sjukhus. The south entrance is not available.

Scenarios evaluation



- Increased demand leads to more uniform passenger distribution at most crowded stations (TEH, STD)
- The operational change at DAS positively affects the downstream stations



Future work

- Further improvement of the train crowding unevenness (TCU) measure
- Evaluate the impact of real time crowding information (RTCI) on train crowding unevenness
- Optimize the layouts of transfer hubs to improve passenger load distribution among train cars



Thank you
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