Evaluating crowding in individual cars of multi-car vehicles
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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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