Smart stations
Smart stations

• Many stations are operating over or near capacity and crowding at stations are connected to on-board crowding.

• Station performance is important for the efficiency and attractiveness of the public transport system.

• Develop methods to support station planning and operations with respect to
  • Passenger streams
  • Impact on crowding in vehicles

• The project supports the final stages of two PhD students.
Modelling on-board crowding

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Background

Overcrowding at stations and on-board PT vehicles

- Discomfort
- Longer dwell times
- Denied boarding
Uneven passenger distribution
- Higher experienced crowding
- Larger fleet requirements
- Higher operating costs
Modelling on-board crowding distribution

BusMezzo - Dynamic Transit Operations and Assignment Model

- Individual transit vehicle movements.
- Individual passenger car boarding choices.
- Experienced passengers wrt car crowding level.
- Captures on-board crowding distribution and evaluates user cost in a more realistic way.
Demand and infrastructure intervention effect

Increased demand ➔

Experienced passengers board less crowded cars.

Closure of an access point ➔

Skewed boarding distribution towards the single entrance at DAS which cancels out at the downstream stations.
Real-time crowding information

• Potential to reduce
  – crowding unevenness.
  – fail-to-board incidents in higher demand scenarios.

• There is still limited research on the inclusion of RTCI in passenger route choice and assignment models.

**Objective:**
Extend existing PT simulation models to account for passengers’ access to car-specific RTCI.
Modelling car-specific RTCI in BusMezzo

• Record the crowding factor in each train car when train departs from a stop.
  – Crowding factor is a function of the car occupancy level.

  • Generate crowding information and update it for each trip segment every time a train trip departs.
    – Generated RTCI is based on the car crowding level of the latest train run only.

  • Each passenger utilizes the generated car-specific RTCI, as an in-vehicle time multiplier of each given line segment, in the decision making process.

<table>
<thead>
<tr>
<th>RTCI level</th>
<th>Car capacity utilization</th>
<th>Crowding factor</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>&lt;80% seated capacity</td>
<td>1.0</td>
</tr>
<tr>
<td></td>
<td>&lt;100% seated capacity</td>
<td>1.2</td>
</tr>
<tr>
<td></td>
<td>&lt;80% total capacity</td>
<td>1.5</td>
</tr>
<tr>
<td></td>
<td>&lt;100% total capacity</td>
<td>1.8</td>
</tr>
</tbody>
</table>

(Drabicki et al. 2020)
Effect of RTCI on crowding unevenness

- Positive statistically significant effects of RTCI on crowding unevenness.

- Improved vehicle capacity utilization - 2% less seats are left empty.
On-going work

- Extend the generation of RTCI, adding dependence on the crowding level of multiple previous train runs.
- Investigate the effect of other control measures on reducing crowding unevenness.
Thank you

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PASSENGER-CENTERED PLANNING
AND CONTROL OF TRANSFER HUBS

Traffic planning at bus terminals

Therese Lindberg
BACKGROUND

• No one likes to transfer
• Need to be well-functioning and facilitate easy transfers
• Previous research:
  • Methods to evaluate the physical planning
  • Could also be used to evaluate the traffic on the terminal
• Now:
  • Improve the planning of the traffic on the terminal
  • How to plan the allocation of buses to stops?
# STOP ALLOCATION

<table>
<thead>
<tr>
<th>What to improve?</th>
<th>What should be allocated?</th>
<th>Allocation at what stage?</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Congestion</td>
<td>• Buses</td>
<td>• Planning</td>
</tr>
<tr>
<td>• Robustness</td>
<td>• Lines</td>
<td>• Real-time</td>
</tr>
<tr>
<td>• Walking distances</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
A SIMPLE MODEL

• Minimize:

  The walking distances for all passengers on all buses from entry to boarding stop, from alighting stop to exit and between transferring buses

• Constraints:

  • Each bus uses exactly one stop
  • Two buses at the same stop can not have overlapping time windows
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