BusMezzo – Dynamic Transit Operations and Assignment Model

Dynamic transit modeling

- BusMezzo was developed to enable the analysis and evaluation of transit performance and level of service under various system conditions and APTS.
- Implemented within Mezzo, a mesoscopic traffic simulation model
- The different sources of transit operations uncertainty are modeled explicitly:
  - Traffic conditions
  - Dwell times
  - Vehicle capacities
  - Vehicle scheduling
  - Service disruptions

Potential applications:
- Public transport performance analysis
- Evaluation of real-time control strategies
- Impacts of transit priority
- Restoration from major disruptions
- Frequency determination
- Timetable optimization
- Layover and recovery time assessment
- Effects of transit route changes
- Real-time passenger information evaluation
- Intermodal coordination design

Traffic dynamics
- Information
- Monitoring and control
- Signal priority

Vehicle scheduling
- Control and management strategies

APTS

Information
- Monitoring and control
- Signal priority

Path choice decisions

- Agent-based modeling
  - OD corresponds to geographical locations (activity anchors, stops)
  - Passenger’s perception depends on prior-knowledge, available information and experience
- Successive travel decisions
  - Using the framework of random utility discrete choice models
  - Choosing between a set of feasible activities
  - The probability to choose a certain action is determined by the joint utility of the corresponding paths
- The utility of a path comprises a trade-off between its attributes values as anticipated by the passenger
- The path utility function was estimated based on survey data

Choice-set generation model (CSGM)

- Two-stage modeling approach
- Non-compensatory CSGM
- Recursive search method
- Merging paths with common lines/stops
- Could be applied as an initial phase that produces a background-set for each OD pair
- The estimation problem was formulated and a simplified version was applied on survey data

Impacts of real-time information (RTI)

- Replicating the method commonly used by transit agencies for generating real-time arrival information
- Adaptive decision making process of both operators and passengers

Case study – Stockholm's rapid transit network

- Metro, inner-city trunk lines, Tågbanan
- Real world timetables, vehicle scheduling and walking distances
- ~100K alternative hyperpaths were generated by the initial CSGM phase
- ~150K passengers during the AM peak hour; Approximated OD matrix

Passenger journey attributes (inner-city)

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- Substantial differences in passenger loads on individual trips
- Particularly advantageous in case of service disruptions
- Could be used for eceonomical assessment of RTI display installation
- Large gains from simple improvements in transfer coordination

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See: Cats O., Burgheleanu W., Toledo T. and Kontopoulos H.N. Modeling real-time transit information and its impacts on travelers' decisions. Submitted to Transportation Research Record, 2022.