Transportation research at the TRANSP-OR laboratory

Presentation of selected projects

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The TRANSP-OR laboratory

- “Directed by Michel Bierlaire, the Transport and Mobility Laboratory is active in modeling, optimization and simulation of transportation systems, with a specific emphasis on the mobility of individuals.”
- 19 members, including
  - 8 PhD students
  - 3 postdocs
- here: presentation of 4 selected projects
Outline

Modeling of pedestrian walking behavior

SOPHOS – traffic signal optimization

Disaggregate behavioral models exploiting data from Nokia devices

Calibration of traffic microsimulators
Outline

Modeling of pedestrian walking behavior

SOPHOS – traffic signal optimization

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Calibration of traffic microsimulators
Modeling of pedestrian walking behavior

- modeling operational pedestrian behavior
- novel application of discrete choice models
- interplay with computer vision
  - use model for pedestrian tracking
  - use tracked pedestrians for calibration

- ongoing series of projects
- Michel Bierlaire, Thomas Robin, Javier Cruz, et al.
- collaboration with Signal Processing Laboratory 5
Calibration and validation

\[
P(i|C) = \sum_{m=1}^{M} \frac{\left( \sum_{j \in C} \frac{\alpha_{jm}^{\mu_m} y_{jm}^{\mu_m}}{y_{m}^{\mu_m}} \right)^{\frac{1}{\mu_m}} \frac{\alpha_{im}^{\mu_m} y_{im}^{\mu_m}}{y_{i}^{\mu_m}}}{\sum_{n=1}^{M} \left( \sum_{j \in C} \frac{\alpha_{jn}^{\mu_n} y_{jn}^{\mu_n}}{y_{j}^{\mu_n}} \right)^{\frac{1}{\mu_n}} \sum_{j \in C} \frac{\alpha_{jm}^{\mu_m} y_{jm}^{\mu_m}}{y_{j}^{\mu_m}}} \]

(0,0)
A selected validation result

Predicted probabilities for Dutch data

Hazard = 1/33
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SOPHOS – traffic signal optimization

- optimization of inner-urban signal timing
- deploys novel analytical queueing model
- links microsimulator to the optimization

- December 01, 2007 – November 30, 2009
- Michel Bierlaire, Carolina Osorio
- sponsor: Swiss National Science Foundation
Interplay of analytical optimization and microsim

\[
\min_{g, \mu, x} \mathcal{T}(g, \mu, x, \alpha) \quad (1)
\]

subject to:

\[
\sum_{p \in \mathcal{P}_I(i)} g_p = b_i, \quad \forall i \in \mathcal{I} \quad (2)
\]

\[
\mu_\ell - \sum_{p \in \mathcal{P}_L(\ell)} g_p s = 0, \quad \forall \ell \in \mathcal{L} \quad (3)
\]

\[
h(\mu, x, \alpha) = 0 \quad (4)
\]

\[
g \geq g_L \quad (5)
\]

\[
\mu \geq 0 \quad (6)
\]

\[
x \geq 0. \quad (7)
\]

- microsimulator (SIMLO) for parametrization, evaluation
- analytical model for optimization
A selected optimization result
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Disaggregate behavioral models exploiting data from Nokia devices

Calibration of traffic microsimulators
Disaggregate behavioral models exploiting data from Nokia devices

- gather mobility & activity information from smart phones
  - 50 survey participants receive free phones
  - phones send ambient information to server
  - supplemented by web-based survey

- use data for advanced mobility & activity modeling

- December 01, 2008 – June 30, 2010
- Michel Bierlaire, Jeff Newman, Jingmin Chen
- sponsor: Nokia Research Center
GPS-tracks

- GPS tracks consist of locations with time stamps
- no immediate information about activities, travel modes, ...
Workflow of supplementary survey

- test persons report daily to web-based survey system
- all data is stored in database for further investigations
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Disaggregate behavioral models exploiting data from Nokia devices

Calibration of traffic microsimulators
Calibration of traffic microsimulators

- basically, disaggregate OD matrix estimation
- calibration of arbitrary behavioral patterns
- details in next presentation

- ongoing sequence of projects
- Michel Bierlaire, Gunnar Flötteröd, et al.
- sponsor: German Research Foundation, EC
Summary

• mathematical models and techniques apply to many transportation problems
• TRANS-P-OR is active in modeling, optimization and simulation of transportation systems
• for more information:

http://transp-or.epfl.ch/