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

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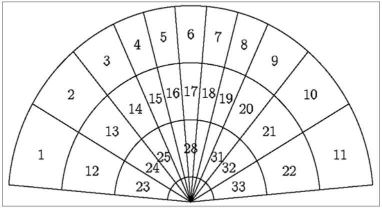
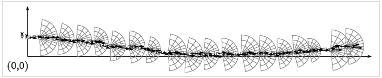
Modeling of pedestrian walking behavior

- 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

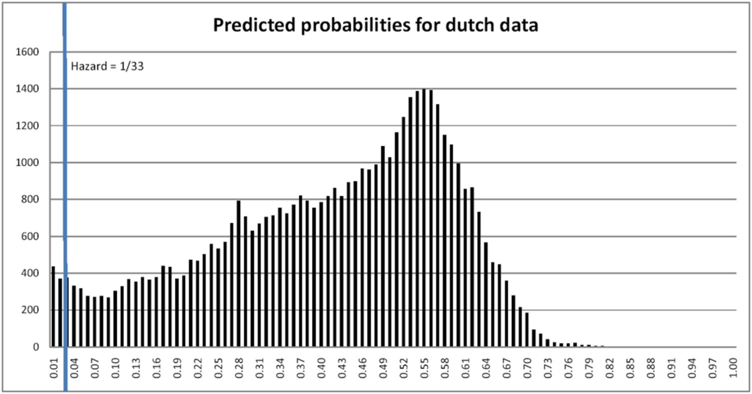
Calibration and validation





$$P(i|C) = \sum_{m=1}^{M} \frac{\left(\sum_{j\in C} \alpha_{jm}^{\mu_m/\mu} y_j^{\mu_m}\right)^{\frac{\mu}{\mu_m}}}{\sum_{n=1}^{M}\left(\sum_{j\in C} \alpha_{jn}^{\mu_n/\mu} y_j^{\mu_n}\right)^{\frac{\mu}{\mu_n}}} \frac{\alpha_{im}^{\mu_m/\mu} y_i^{\mu_m}}{\sum_{j\in C} \alpha_{jm}^{\mu_m/\mu} y_j^{\mu_m}}$$

A selected validation result



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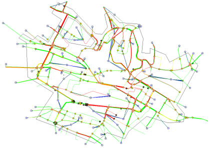
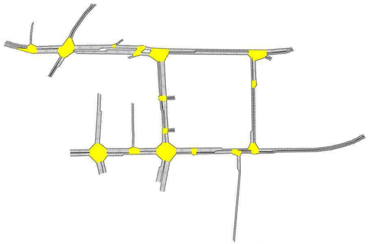


- optimization of inner-urban signal timing
- deploys novel analytical queueing model
- links microsimulator to the optimization

- December 01, 2007 – November 30, 2009
- Michel Bierlaire, Carolina Osorio
- sponsor: Swiss National Science Foundation

FNSNF
Fonds national suisse
Schweizerischer Nationalfonds
Fondo nazionale svizzero
Swiss National Science Foundation

Interplay of analytical optimization and microsim



$$\min_{\boldsymbol{g},\mu,\boldsymbol{x}} \; T(\boldsymbol{g},\mu,x,\alpha) \quad (1)$$

subject to:

$$\sum_{\boldsymbol{p}\in\mathcal{P}_{\mathcal{I}}(\boldsymbol{i})} \boldsymbol{g}_{\boldsymbol{p}} = \boldsymbol{b}_{\boldsymbol{i}}, \;\; \forall i \in \mathcal{I} \quad (2)$$

$$\mu_\ell - \sum_{\boldsymbol{p}\in\mathcal{P}_{\mathcal{L}}(\ell)} \boldsymbol{g}_{\boldsymbol{p}}\boldsymbol{s} = 0, \;\; \forall \ell \in \mathcal{L} \quad (3)$$

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

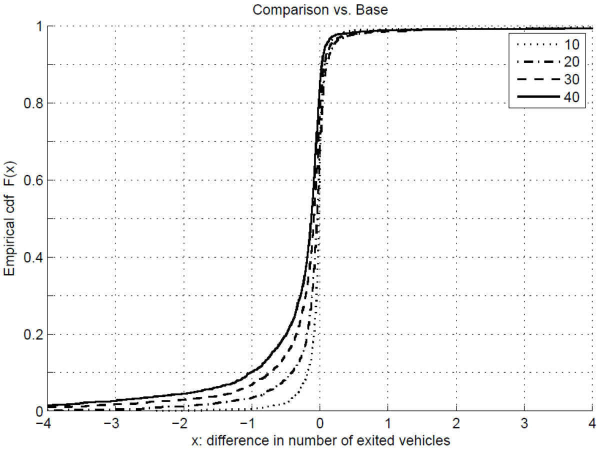
$$\boldsymbol{g} \geq \boldsymbol{g}_{\boldsymbol{L}} \quad (5)$$

$$\mu \geq 0 \quad (6)$$

$$x \geq 0. \quad (7)$$

- 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

- 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

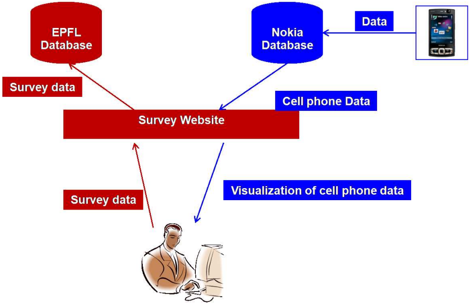
- December 01, 2008 – June 30, 2010
- Michel Bierlaire, Jeff Newman, Jingmin Chen
- sponsor: Nokia Research Center

NOKIA
Connecting People

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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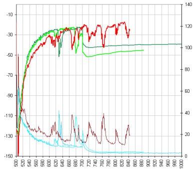

- basically, disaggregate OD matrix estimation
- calibration of arbitrary behavioral patterns
- details in next presentation

Deutsche Forschungsgemeinschaft DFG

- 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
- TRANSP-OR is active in modeling, optimization and simulation of transportation systems
- for more information:

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