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Microsimulating Choices of Different Agent Types: Shoppers and Retailers

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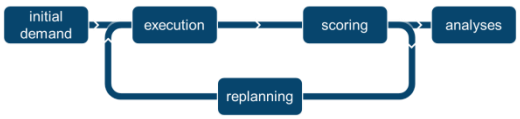
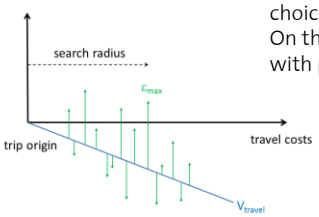
INTRODUCTION

MATSim – A Co-Evolutionary Algorithm



- Agents iteratively replan their daily schedules until system reaches relaxed state. Choice dimensions: time, route and destination choice.
- Movement is microsimulated (execution)
- Utility function $U = U_{travel} + U_{activity\ performing}$ with $U = V + \varepsilon$ (discrete choice framework) used for scoring.

Shoppers' Destination Choice [1]



choice = max U
On the fly re-generation of ε_{pq}
with p: person q: alternative

Retailers' Location Choice [2]

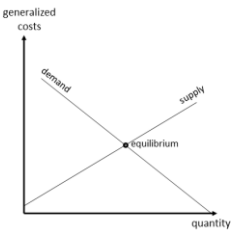
- Market support analysis
- Max. accessibility for potential customers

$$\min \sum_{i}^{n} \left(\sum_{j}^{m} c_{i,j} / m \right)$$

c = generalized costs
m = # potential customers

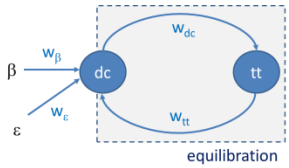
Transport System Equilibrium

- Central to transport planning and economics
- Costs are *not* fully determined thus they are subject to choice uncertainty



DISCUSSION

Approximate Calculation of Travel Times



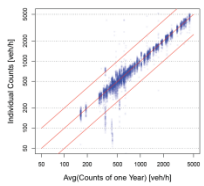
- $err_{tot} = w_\beta\, err_\beta + w_\varepsilon\, err_\varepsilon + w_{tt}\, err_{tt}$
- If (w_{tt} = small) -> tt can be approximated
- Equilibrium concept is approximate itself

Existence, Uniqueness and Stability of Equilibrium

- Microsimulations are a sampling tool [3]. Drawing from error terms of utility function -> results are distributions and have to be given together with measures of spread.
- What does existence, uniqueness and stability mean in this stochastic setting?
- No tools available yet for microsimulations (as for aggregate models).

Behavioral Basis of Equilibrium

- Is equilibrium ever achieved under uncertainty (changing environment)?
  - count data show large temporal variability
  - few empirical data



- Path from non-equilibrium to equilibrium states often not modeled with behavioral models.

Combined Equilibrium: Normative or Behavioral Model?

- Iteratively find a point where shopping location (for shoppers) and store location (for retailers) are stable.
- The two processes have different time scales, their representation in the simulation is therefore problematic -> what does the combined equilibrium represent?
- How to model retailer location choice heuristics?

PROBLEM

Computation Times

Goal: Switzerland overnight run (7.5 M agents)
Now: 2 Days for Zurich region (70 K agents) x retailer location choice -> very slow!

Foundation and Attributes of (Combined) Equilibrium

Few conceptual and empirical knowledge about transport microsimulation equilibrium/equilibria

REFERENCES

[1] Horni, A., K. Nagel and K.W. Axhausen (2011) High-Resolution Destination Choice in Agent-Based Demand Models, paper presented at the *91th Annual Meeting of the Transportation Research Board*, Washington, D.C., January 2012.

[2] Ciari, F. and K.W. Axhausen (2012) Modeling Location decisions of retailers with an agent-based approach, paper presented at the *91th Annual Meeting of the Transportation Research Board*, Washington, D.C., January 2012.

[3] Horni, A., D. Charypar and K.W. Axhausen (2011) Variability in Transport Microsimulations Investigated With the Multi-Agent Transport Simulation MATSim, Arbeitsberichte Verkehrs- und Raumplanung, 692, IVT, ETH Zürich, Zürich.

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