Incorporating “Mental Maps” in Route Choice Modeling: Preliminary Ideas

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Outline

• Background
• Methodological directions
• Data
• Preliminary results and applicability
• Conclusion
Route choice

Maybe the most challenging component of travel behavior.

- High requirements in data;
- Physical overlap of paths;
- Size and composition of choice set.

Find ways to facilitate route choice modeling and incorporate behavioral aspects.
Motivation

• “The concept of path, which is the core of a route choice model, is usually too abstract for a reliable data collection process.” (Frejinger, 2008)

• “People are in general able to identify a sequence of locations that they have traversed, but have difficulties describing a full path in detail.” (Frejinger, 2008)

• “…in describing the neighborhood between her house and her school a young child typically will draw a map by starting at her home and filling in places as though walking from home to school. Her cognitive map is organized along a path in which one landmark follows another.” (Golledge, 1999)
Anchor points (APs)

Dual role in the transportation environment:
• Organizing elements of peoples cognitive maps
• Wayfinding

Anchors can be demarcated in:
• Common anchors
• Individual (personalized) anchors:
  • Home;
  • Work;
  • Individual-specific landmarks (linked to activity patterns).
From paths to anchor point sequences

- Being in the shoes of the drivers motivates a less rigid definition of paths.

⇒ Representation –and modeling– of “paths” in a higher conceptual level as sequences of anchor points.

⇒ Not a path anymore but an anchor point sequence.

✓ Break down the combinatorial complexity.
Objective

- Introduce the idea of the framework;
- Briefly describe the data;
- Get your feedback!!
Modeling route choice in a higher level

What are we interested in is individual’s higher level decision: from EPFL to Geneva through the highway...

..conditional on that there is a path decision (observed path). This will be simplified...
From network to mental map

Various layers of importance

Path on the physical network

Behavioral view

Engineering view
Mental map

- AP sequences: set of artificial alternatives
- List of APs

Need to formally define APs-operationalization of concepts:

- Various levels of abstraction.
- Combination of a methodological and a behavioral approach.
Building the mental map...

Behavioral input:
- Survey people

Methodological input:
- Data: frequency
- Land use, POI locations
- Network attributes: connectivity
Route choice modeling framework (cont.)

We build on the route choice framework developed by Frejinger (2008), and further developed by Chen (2013).

✓ Probability of observing path \( p \) given the set of \( AP \) sequences \( C\{AP\} \) is:

\[
P_n(p | C\{AP\}) = \sum_{AP \in C} P_n(AP | C\{AP\}; \beta) \cdot P_n(p | AP)
\]
Then, the probability of reproducing observation $i$ of traveler $n$ given $C\{AP\}$ is decomposed as:

$$P_n(i | C\{AP\}) = \sum_{p \in P_n} \sum_{AP \in C} P_n(i | p) \cdot P_n(AP | C\{AP\}; \beta) \cdot P(p | AP)$$

$i$: observation i.e. a sequence of GPS records;
$p$: the actual path on the physical network;
$AP$: a sequence of APs.
Overview of the collected data

Nokia Data Collection Campaign (LDCC), 2009-2011

• ~200 Nokia N95 smartphone users in Geneva Lake area
  • GPS points;
  • Nearby Wi-Fi and blue tooth access points;
  • Acceleration records;
  • SMS and call log records;
  • calendar entries; ...

• Basic socio-economic information for 158 users
• Home, work and main grocery addresses for 21 users
Previous work on the data (Chen, 2013)

• Challenges related to measurement errors and low frequency in reported data.

• Framework to infer paths:

  Probabilistic path observations comprising of sets of candidate paths, each associated with a corresponding measurement likelihood.
Most frequently visited links
Most frequently visited links (cont.)
Conclusion

- Several issues to be addressed in the base of the framework.
- Need to deal with the limitations of the data as well.
- Simpler, more realistic representation of the man-environment interface.
- Advantages:
  - Size of the choice set
  - Simpler correlation structure; perceptual correlation

☞ First steps underway:
  - Literature review and definition appropriate terminology
  - Conduct a survey; questionnaire or interviews?
  - Explore the data