

An empirical agent-based model of parking behaviour

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3^e Kuhmo-Nectar Conference
3-4 July 2008

Motivation
Modelling parking
Behavioural model
Concluding remarks

Outline

- Motivation.
- Modelling parking.
- Behavioural model.
- Concluding remarks.

The parking problem

- At each destination a car needs to park.
- Average car spends 95% of a day parked; 23 hours a day.
- Cities were not planned with today's demand for parking in mind.
 - Parking problems in many cities.
 - Parked cars use up valuable land, cause visual hindrance.
 - Cruising for parking causes congestion, emissions, noise...

A growing problem

- Automobile ownership still rising
- Increasing mobility and greater demand for transportation.

➔ Greater demand for parking?

➔ More parking problems?



Parking solutions

- Parking sits at the intersection of the urban transportation system and urban land use.
- Many solutions proposed
 - Park-and-ride
 - Carsharing
 - Correct parking pricing
 - Parking management
 - ...



Impact and efficacy

- But impact and efficacy of solutions are not known.
 - Need for modelling.



State-of-the-art: theory

- Economics:
 - Aggregate, macro-economic methods.
 - Internalise costs of searching.
 - Set optimal price if road use is underpriced.
 - Cost of enforcement?
- Transportation engineering:
 - Models for behaviour in parking lots (PARKSIM).
 - Parking design models.
 - Parking choice models.
- Assessment of urban parking policies?
- Behavioural response of parkers to policies?

State-of-the-art: empirical

- Very little is known.
- Cruising for parking: how many?
- Searching for a parking place: how long?
- Relation between parking and car trip generation?
- True costs of parking?

Concept for a parking model

- Local phenomenon.
 - High level of spatial detail.
- Many individual decisions based on local, temporal circumstances.
 - Behavioural model.
- Large individual taste heterogeneity.
 - Mixed multinomial logit model preferred.
- Computational load too heavy for large models.
 - Nested logit in practice.

SUSTAPARK

- SUSTainable PARKing
- Parking policy model for cities.
- Micro-simulation.
- Spans a whole day.
- High level of detail:
 - Cellular automaton for street network.
- Behavioural model:
 - Individual drivers agent-based.
 - Based on behaviour research.
- Trips derived from sample activity schedules.

Behavioural model: concept

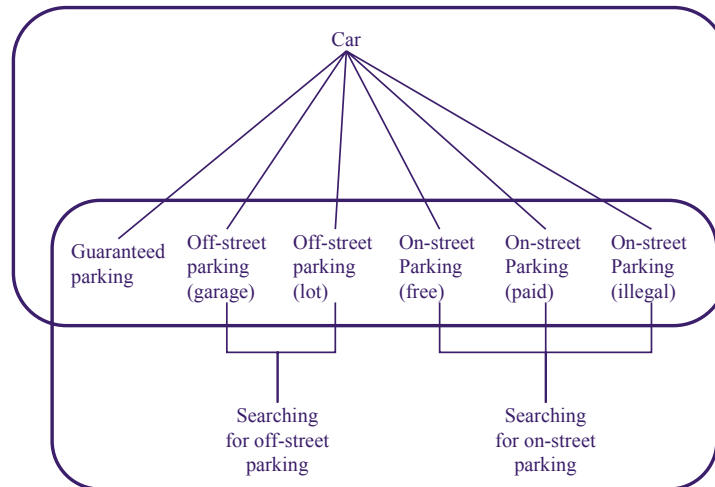
- 2 parts.
- Pre-trip choice of an initial strategy.
 - In more advanced form also mode choice.
- (Driving towards search area.)
- Application of search algorithm in area around destination.



Pre-trip choice model

- Model taken from Hess and Polak (2004).
- Division by trip purpose (work and other).
- Based on expected values.
- Assumption: driver has full knowledge.
- Included variables:
 - Access time.
 - Search time.
 - Egress time.
 - Cost of parking.
 - Cost of fining.
 - Alternative specific constants (free on-street parking as reference level).

Pre-trip choice model



On-street behaviour

- Guiding principle:
a driver wants to park as close as possible to his destination, given cost constraints.
- If driver has arrived at the destination area
➡ executes chosen parking strategy
- Guaranteed parking
- On-street parking
- Off-street parking

On-street parking

- Starts to look ahead for a free parking place.
 - Look ahead distance affected by tailgating.
 - At about 200 m from destination.
- If a free place is found:
 - If occupancy ratio is low, driver tries closer to destination.
 - Park otherwise.
- If no free place is found:
 - Driver first re-evaluates current strategy with updated values for the parameters.
 - Chooses new street on the basis of the relative occupancy ratios.

Off-street parking

- Driver first drives to the chosen parking lot or parking garage.
- If free places available → park.
- If not, driver re-evaluates current strategy.
 - Driver goes to next nearest parking lot or parking garage.
 - If a free place is encountered en route → park.

Concluding remarks

- Limited data available
- More quantitative research in behaviour needed.
- Attitude of public towards new parking policies?