What can we learn from Simulating Commuters?

N. Urquhart

School Of Computing
Edinburgh Napier University

November 2017

Commuting
Why model commuting?
A commuting model
Decision making
Results. . . .
Summary

Contents

Commuting

Why model commuting?

A commuting model
    Decision making

Results....

Commuting

Commuting accounts for 20 % of all journeys made in the UK. Stakeholders include

- Commuters
- Employers
- Local authorities
- transport providers

What is commuting?

What is commuting?

- The journey to work
- The journey from work

What are the decisions for the commuter?

- What time shall I travel?
- How shall I travel?

What's the problem?

- Commuting is mostly unavoidable. Some people can work from home, but most cannot (yet).
- Commuting strains transport networks, most still work a notional 9-5 day
- Many interventions are possible, but how does an organisation know which one to use?

What can a model tell us?

- **Individual**
- **Employer**
- **Transport provider**
- **Local Authority**

What can a model tell us?

- **Individual**
  What are the effects of my decisions?
  What are the options open to me?
- Employer
- Transport provider
- Local Authority

What can a model tell us?

- Individual
- **Employer**
  What is the impact of my workforces' commuting activities?
  What interventions are open to me?
  What is the likely effect of these interventions?
- Transport provider
- Local Authority

What can a model tell us?

- Individual
- Employer
- **Transport provider**
  What is the current demand from commuters?
  What demand could be generated from interventions?
- Local Authority

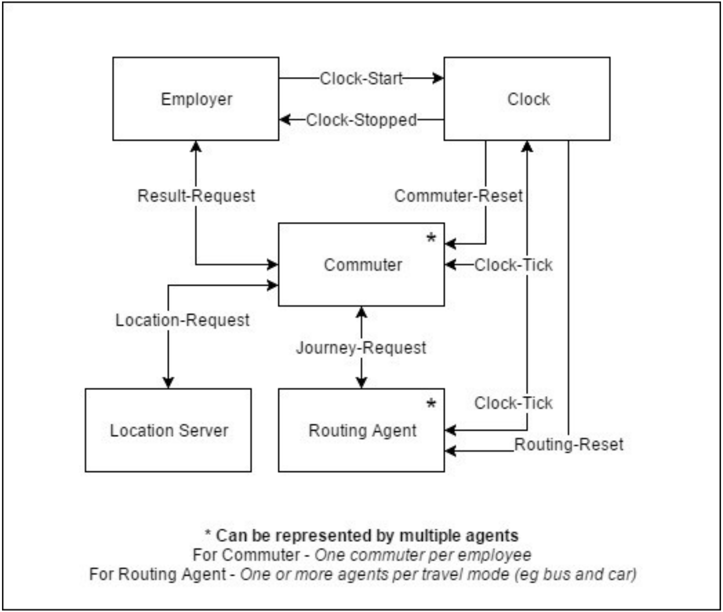
What can a model tell us?

- Individual
- Employer
- Transport provider
- **Local Authority**
  What is the impact of commuting in my area?
  What interventions across employers may reduce the impact?

A basic model

- 1 commuter == 1 agent
  Commuter decisions...
  - Travel mode to work
  - Travel mode from work
  - Work start time
  - Work finish time
- Other stakeholders represented by agents/institutions
  - Provide data to agents
  - Provide feedback to agents

MAS Structure



Data sources

The simulation can only be as accurate as the data sources allow!

- Road network data - Open Streetmap
- Public Transport network data - TravelLine Scotland
- Postcode data - Ordnance Survey

Agents

- Agents are based upon individual employees.
  - Upcoming data protection issues - with using payroll data.
- Current model uses postcode data based on ENU payroll.
- Agent decisions and further info from ENU travel survey.

Decisions...

- Each agent must model the human-like decision process involved in commuting
- Must attempt to encompass the multiple factors that determine a decision
- Our initial idea is based on the established Belief Desire Intention framework.

BDI (recap)

- **B**elief - What I know about the world
- **D**esire - Things that I would like to achieve
- **I**ntention - Things that I could do (options)

BDI for commuters

- **Belief - What I know about the world**
- Desire - Things that I would like to achieve
- Intention - Things that I could do (options)

My initial beliefs are the time and cost associated with each travel mode. Based upon data available to me.

BDI for commuters

- Belief - What I know about the world
- **Desire - Things that I would like to achieve**
- Intention - Things that I could do (options)

My desires could include things like - I want to minimise traveling time, I want to spend as little money as possible or I want to travel by car.

Commuting
Why model commuting?
A commuting model
Decision making
Results....
Summary

BDI for commuters

- Belief - What I know about the world
- Desire - Things that I would like to achieve
- **Intention - Things that I could do (options)**

Possible intentions open to me are traveling by car, public transport or cycling. Modes will be governed by factors such as access to a car, availability of public transport or the practicalities or cycling.

A BDI Implementation

1. Beliefs = default journey times
2. CurrentMode = quickestJourney
3. Patience = rand (5-10) *Days agent will put up with sub standard journey*
4. While not last day
5. Undertake journey
6. Get feedback
7. If (feedback == no car parking space) journeyTime = journeyTime + 30 //Penalty no parking
8. If (feedback == no bike parking space)JourneyTime = journeyTime + 10 //Penalty no space
9. If (journeyTime ¿ journeyTime) Patience – //Things have gotten worse
10. If (journeyTime ¡ journeyTime) Patience ++ //Things have improved
11. //Are there any better options?
12. BestT = getBestTime (beliefs)
13. If (JourneyTime ¡ bestTime) patience –
14. Belifes.update(JourneyTime)
15. If (patience == 0)
16. mode = getQuickestMode(beliefs)
17. patience = maxPatience
18. endif
19. endWhile

Initial results

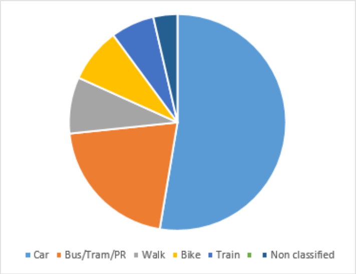


Figure: The modal split suggested in the ENU travel survey

Initial results - Travel by mode

Table: Split of Commuters By mode

Mode	Overall	Sighthill		Craiglockhart		Merch	
	Survey	Survey	Sim	Survey	Sim	Survey	Sim
Car	52.62%	62.61%	66.77%	60.61%	95.37%	33.33%	35.19%
Bus	20.72%	23.11%	23.35%	15.15%	3.40%	18.75%	43.89%
Foot	8.43%	0.84%	0.78%	11.11%	0.00%	16.67%	2.22%
Bike	8.15%	5.04%	8.78%	8.08%	1.23%	14.58%	14.44%
Rail	6.49%	5.46%	0.31%	2.02%	0.00%	11.46%	4.26%
NA	3.59%	0.00%		3.03%		5.21%	

Table: Ordering of Commuters by modal split

Overall	Sighthill		Craig		Merch	
Survey	**Survey**	**Sim**	**Survey**	**Sim**	**Survey**	**Sim**
Car	Car	Car	Car	Car	Car	Bus
Bus	Bus	Bus	Bus	Bus	Bus	Car
Foot	Rail	Bike	Foot	Bike	Foot	Bike
Bike	Bike	Foot	Bike	Foot / Rail	Bike	Rail
Rail	Foot	Rail	Non classified		Rail	Foot
Non classified	Non classified		Rail		Non classified	

Summary

- Commuting represents a massive contributor to travel related impacts (congestion, pollution etc)
- Any attempt to reduce commuting could have a massive impact on quality of life
- A realistic model of commuting will help us understand the impact of commuting and highlight areas for improvement.
- Given that commuting is a human centred problem, it lends itself well to a software agent based model