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Shared, autonomous, connected and electric urban transport

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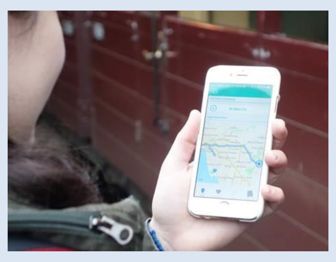
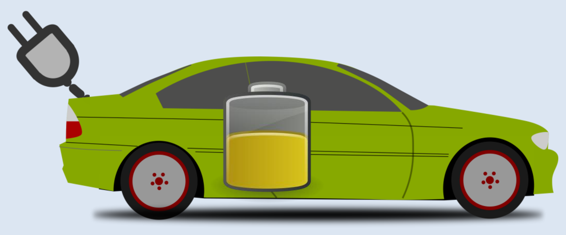
Emerging technologies



IT platform

Autonomous cars



Electric cars

Project objective

We aim to explore the feasibility of a demand-responsive transport mode in the urban transport fabric. This mode provides ad-hoc point-to-point transport, which includes serving the last mile problem: transport from and to mass transport hubs. Vehicles of this novel mode should ideally be:

- connected for call and coordination,
- driverless (for trust and safety issues),
- economically feasible to be integrated in public transport schemes.

Sustainable future

Demand-responsive transport (DRT) mode with electric, driverless vehicles

Results from different aspects of the project

Simulation platforms for DRT

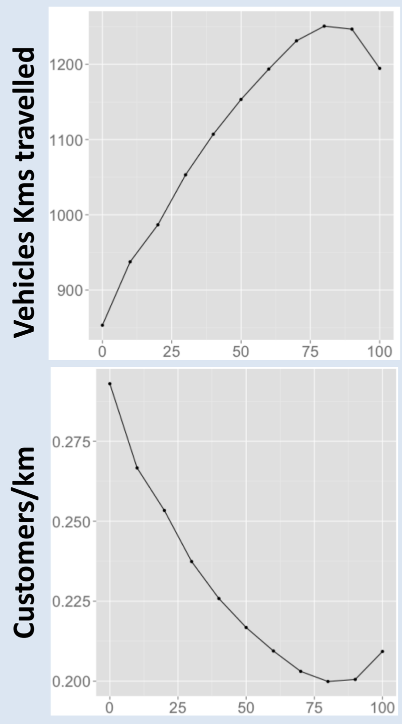
	Advantages	Disadvantages
Isolation (Delphi)	Computationally fast	No integration with other modes "Perfect" travel times
Agent-based simulation (MATSim + *dvrp*)	Can handle all-day plans Can potentially integrate with other modes	Changes to daily plans difficult
Traffic microsimulation (SUMOoD)	Can explore small infrastructure changes e.g., traffic priority, effect of frequent stopping on traffic Can potentially integrate with other modes	Difficult to predict travel time Can only simulate small areas More calibration needed

- *Delphi*: useful for determining areas to study further.
- *MATSim*: relatively low computational cost to simulate DRT without full integration (no other traffic).
- *SUMOoD*: more realistic vehicle simulation, yet causes more complications and a higher computational cost.

The effect of ad-hoc demands on a feeder service

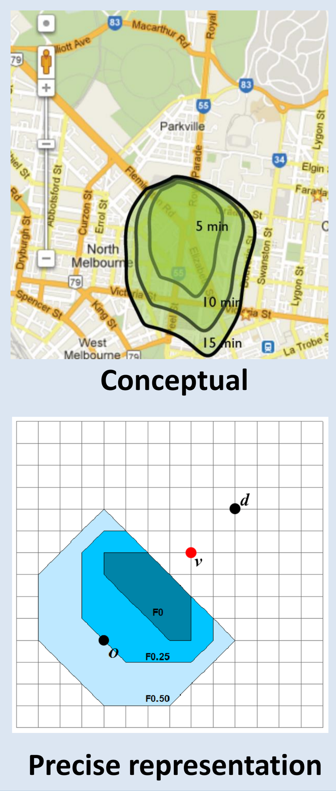
The proportion of ad-hoc demand (immediate pick-up request) determines the performance of the feeder service (to a train station).

- Location of ad-hoc demands are typically closer to train station.
- Fleet routes are re-optimized each time a new request is received.
- Routes chosen minimize the Vehicle Kilometers Travelled.
- Worst performance occurs when demand type are mixed (≈80%).



Improved user interface using launch pads

Routing feasibility can be handled by providing information to clients on possible pick-up areas (i.e. launch pads).



- Launch pad is a geographic representation of aggregated DRT service potential.
- Flexibility constraints of passengers on-board dictate launch pad sizes.
- Map-based UI implementation for mobile devices helps users make decisions under uncertainty.

Conclusion

- Existing simulation packages require extensions to enable DRT full integration.
- Ad-hoc demand causes performance degradation to a DRT service; routing improvements are required.
- The use of IT platforms to provide information eases users' decision making, potentially increasing the feasibility and uptake of DRT.

Ongoing work

- Development of MATSim to enable full integration of DRT, including other traffic, and using it for investigating the impact of DRT to the system.
- Using surveyed travel data, investigating the factors that determines susceptibility of an area to implementation of DRT.
- Improving the quality of the travel data collected through a smartphone tracking sensors.
- Implementation of better routing and scheduling algorithm to improve the performance of the DRT.

References

1. N. Ronald *et al.*, "Simulating ad-hoc demand-responsive transportation: A comparison of three approaches," in *TRB Annual Meeting*, under review.
2. R. Kelly *et al.*, "Exploring the effects of mixed request scheme for demand-responsive feeder service," in *Proc. 21st MODSIM*, 2015.
3. M. Rigby *et al.*, "An opportunistic client user interface to support centralized ride share planning," in Proc. 21st ACM SIGSPATIAL, 2013.
4. M. Rigby *et al.*, "A continuous representation of ad-hoc ride sharing potential," *IEEE Trans. Intell. Transp. Syst.*, under review.

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Research partners

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Research team

Intelligent Mobility on Demand (**iMoD**)
http://imod-au.info/