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Can real-time curb availability information improve urban delivery efficiency?

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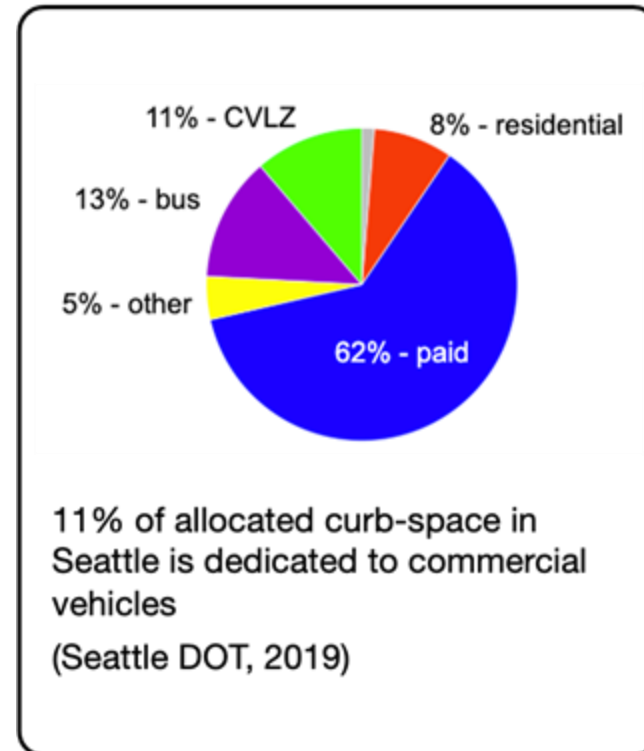
- Delivery challenges in urban areas
- Intelligent parking systems
- OpenPark: a real-time curb availability information system
- Experimental design & data collection
- Results

Delivering in urban areas is increasingly challenging

Freight parking demand



Freight parking supply



Cruising for parking

Parking demand \rightarrow parking supply = cruising for parking



Cost of cruising for parking

- Internal cost: 30 seconds to 15.4 minutes of mean cruising time
- External cost: 7-74% share of traffic is cruising, 1h parked \rightarrow 3.6 cars to cruise

Do commercial vehicles cruise for parking?

YES! Using GPS data from two different carriers we estimated that a parcel delivery driver spends on average 50 minutes a day cruising for parking

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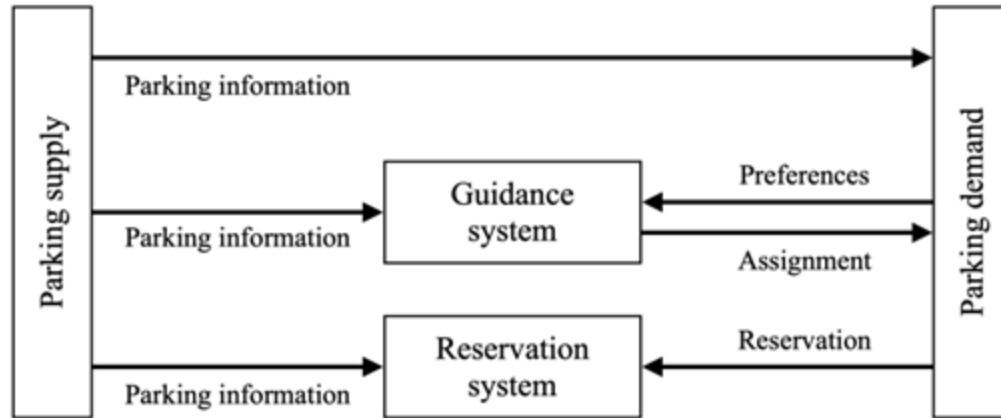
Do commercial vehicles cruise for parking? Empirical evidence from Seattle 

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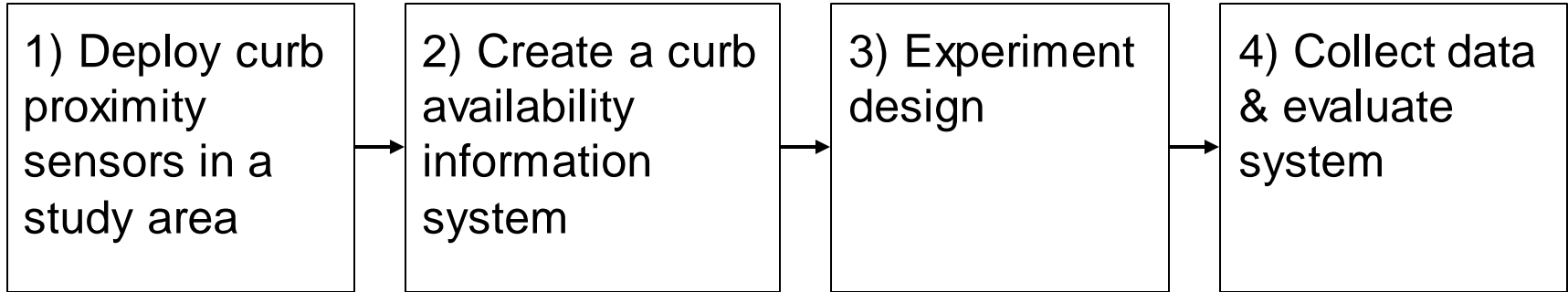
Intelligent parking systems

Intelligent parking systems use real-time curb availability information to improve drivers' parking experience and reduce parking externalities



→ Can **parking availability information** reduce delivery vehicles cruising for parking and improve delivery efficiency?

Methodology



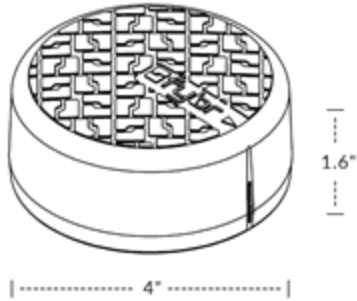
OpenPark



Study area



- Belltown neighbourhood, Seattle
- Vendor: Fybr
- 273 magnetic field sensors
- CVLZs + PLZs



Sensor



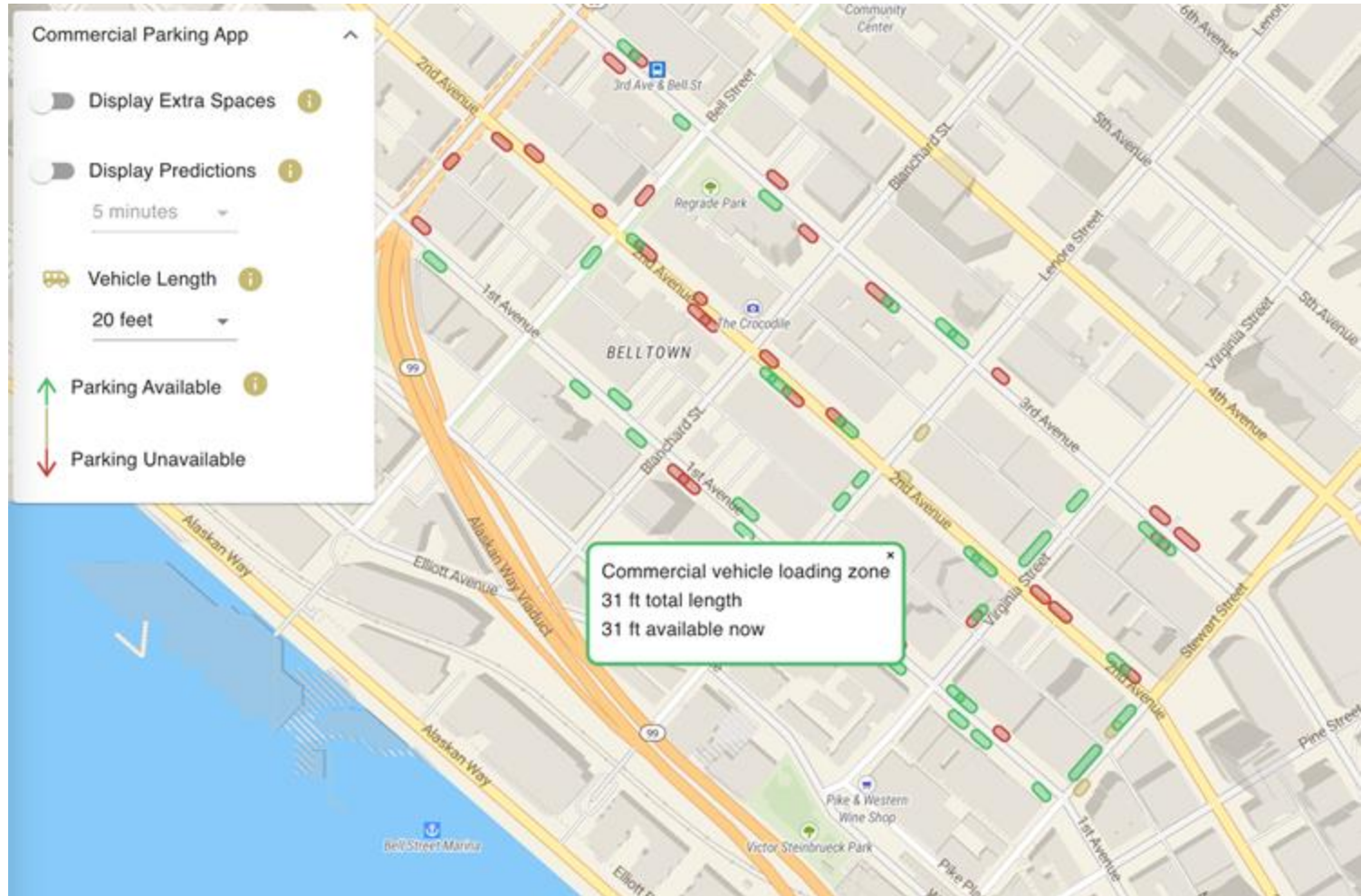
Deployment



Gateway

Open park

Real time & predicted parking occupancy of CVLZs and PLZs



Evaluation

→ Randomized experiment (treatment=app, control=no app.)

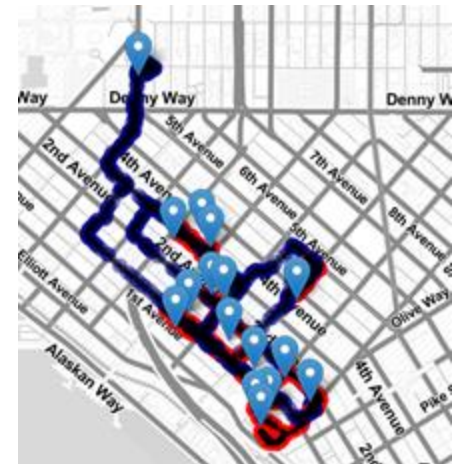
1) Created synthetic delivery manifests



2) Hired drivers to perform deliveries w/o app



3) Data collection & analysis (app vs. no app)



Experimental design

- Hired 11 delivery drivers
- Each driver performed 3 different manifests (3 routes), each containing 15 delivery addresses
- Each driver performed at least 1 manifest using OpenPark for real-time curb availability information, and 1 without

Drivers	Manifests										Total no. routes
	M1	M2	M3	M4	M5	M6	M7	M8	M9	M10	
D1	No app	No app							App		3
D2		App	App	No app							3
D3			App		No app	No app					3
D4	App					App	No app				3
D5		No app		No app				App			3
D6				No app	App		No app				3
D7						App	No app	App			3
D8			No app		App				No app		3
D9	No app			App			App				3
D10				App				No app		No app	3
D11							App	No app		App	3
Total no. routes	3	3	3	5	3	3	5	4	2	2	33

No app = route was performed without access to OpenPark app
 App = route was performed with access to OpenPark app



Data collection

Observers rode along with drivers and collected GPS data

Performance metrics

- Cruising for parking time
- Cruising for parking distance
- Route time
- Route distance

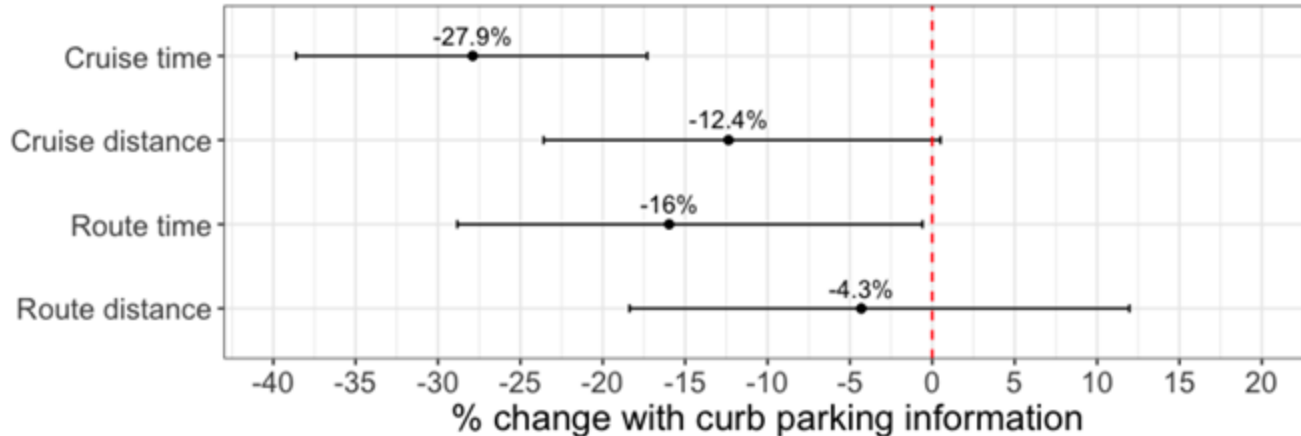
Performed

- 33 routes
- 495 deliveries
- 177 trips



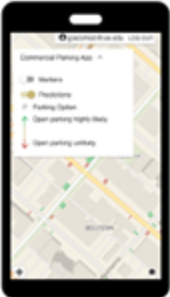
Results

- Estimated four mixed-effect random intercept regression models
- Each model contained a binary variable $1_{[App]}$ which takes value 1 whenever OpenPark was used
- The estimated coefficients for $1_{[App]}$ quantify the impact of using OpenPark on the performance metrics



Conclusion

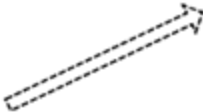
Two options for using data:



real-time parking information app



Cost and time savings



Thank you!

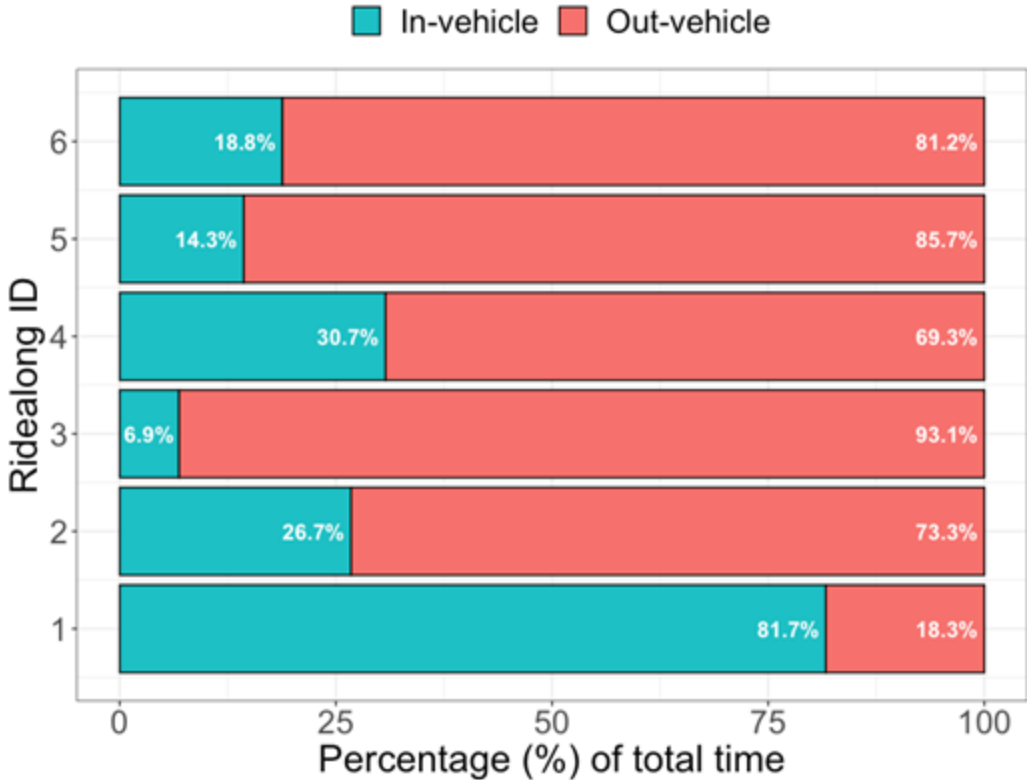
Giacomo Dalla Chiara (giacomod@uw.edu)



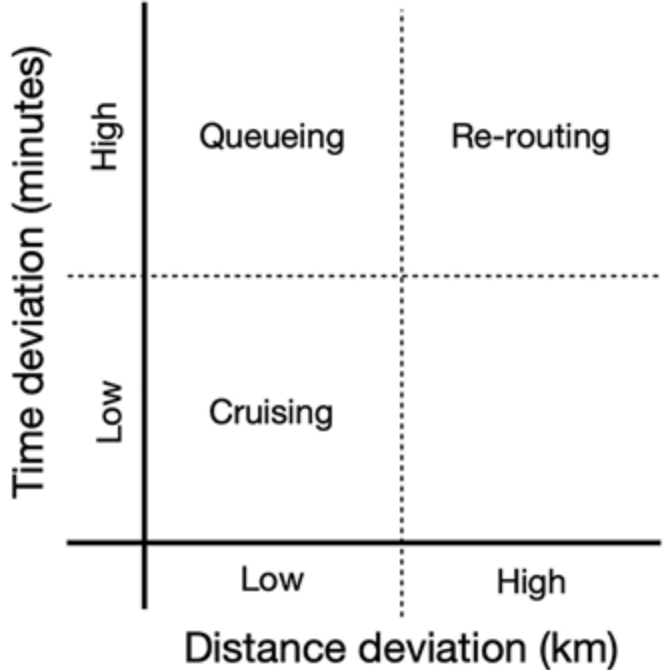
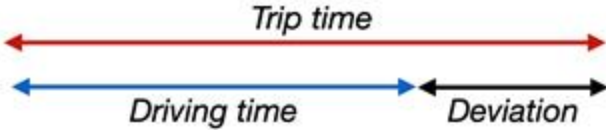
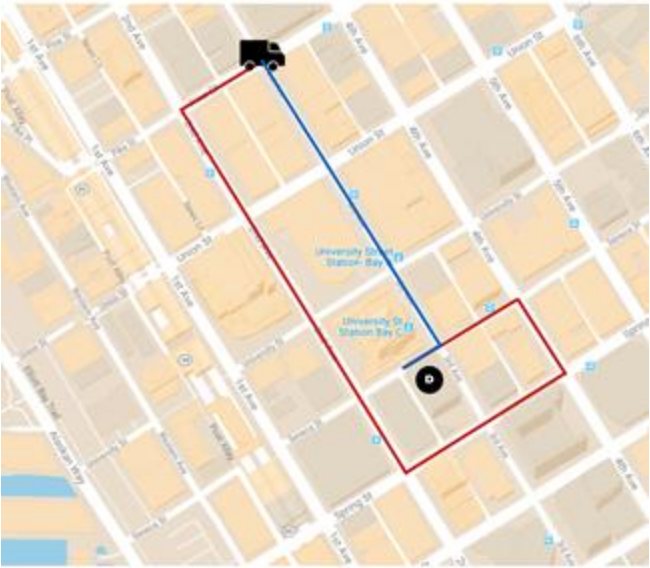
→ Can **parking availability information** reduce delivery vehicles cruising for parking and improve delivery efficiency?



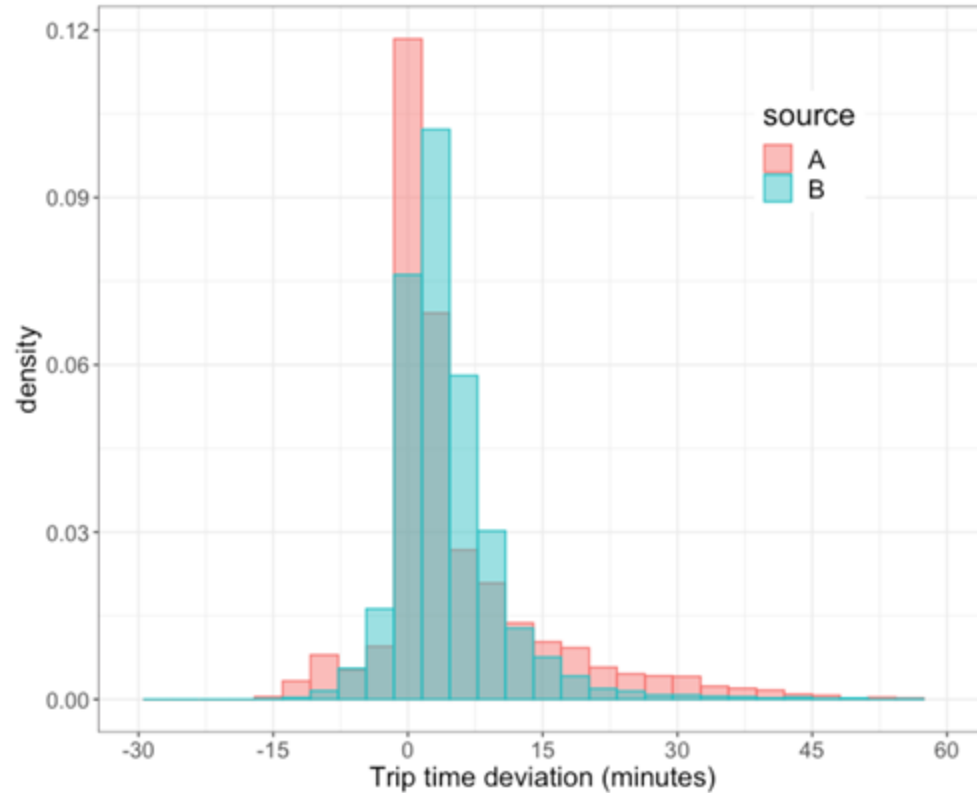
How much of a driver's time is spent parking?



Commercial vehicle parking behaviors



Trip deviation = Real trip time - Estimated travel time



Stat	A	B
1st Qu.	0.47	1.08
Median	2.13	3.27
Mean	5.43	4.44
3rd Qu.	7.88	6.46

Num. trips	25	6
Tot. Time	53 min.	20 min.

Unauthorized parking



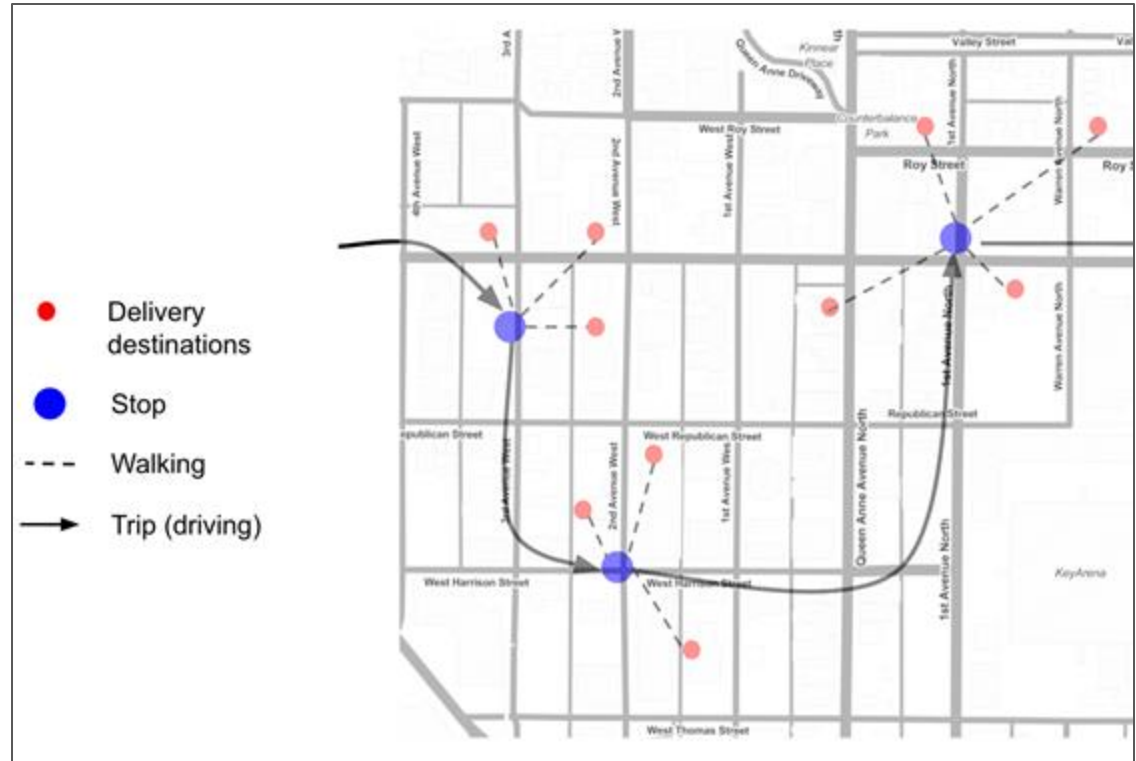
City	Data	Parked in the travel lane*	Reference
Chicago	Citations	2.8%	Kawamura et al. (2014)
Toronto	Citations	2.4%	Wenneman (2015)
New York	Field observations	2.5%	Jaller et al. (2013)
Seattle	Field observations	2.0%	Girón-Valderrama et al. (2019)

* % of unauthorised parking

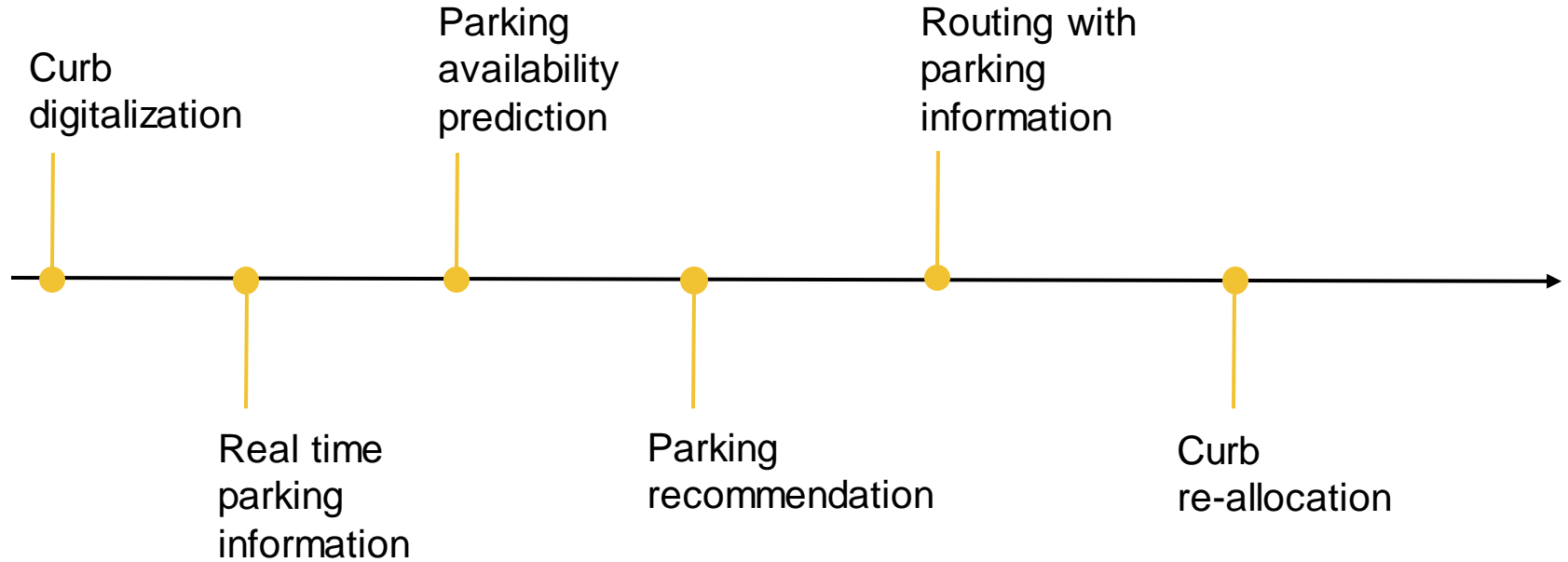
Hypotheses

Performance metrics:

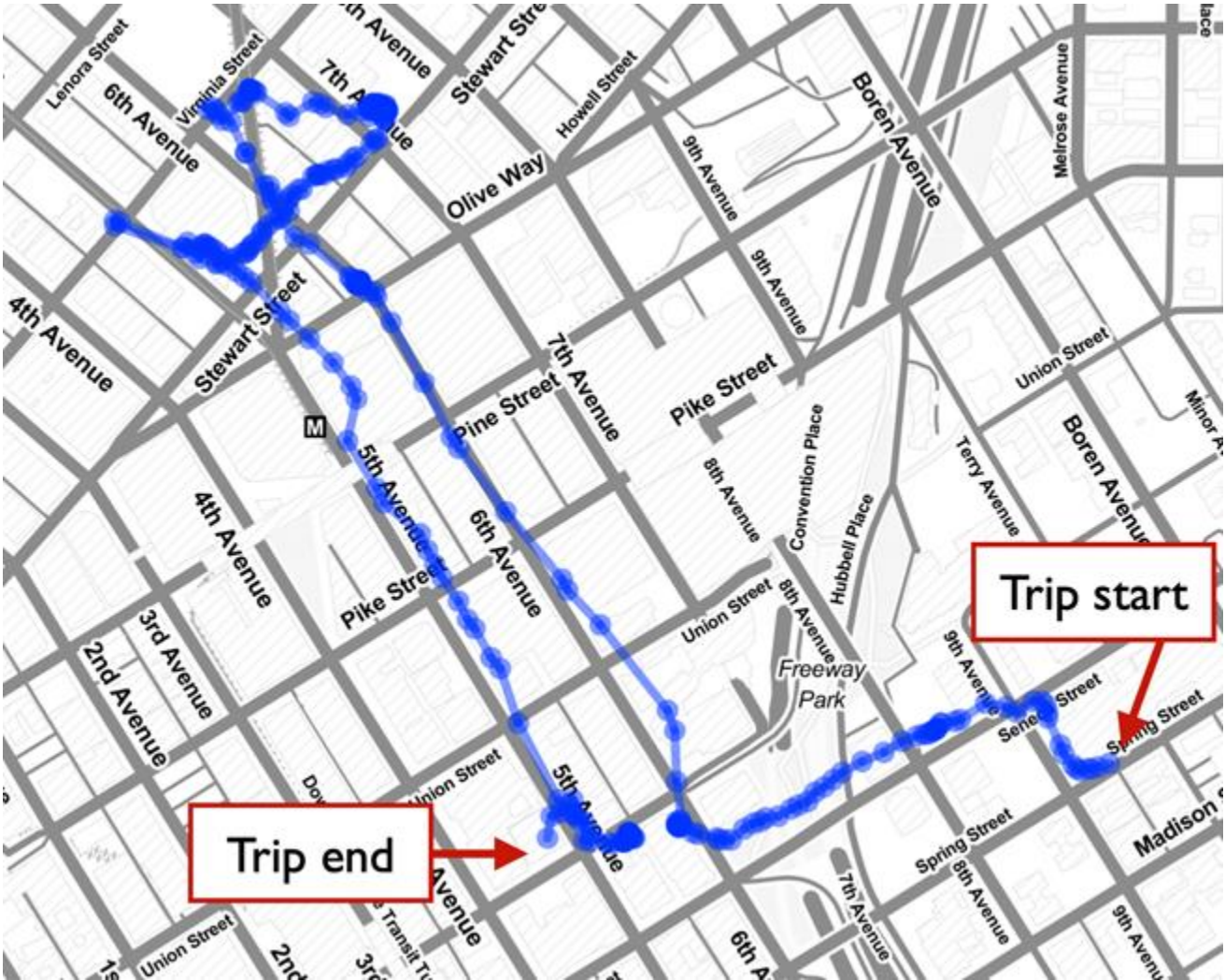
- Cruising for parking time
- Stops per route
- Deliveries per stop
- Dwell time
- Delivery to parking distance



Roadmap



Re-routing



References

- G. Dalla Chiara et al. (2021) *Understanding Urban Commercial Vehicle Driver Behaviors and Decision Making*, Transportation Research Record, <https://doi.org/10.1177/03611981211003575>
- J. Holguin-Veras et al. (2015) NCFRP 33 - Improving Freight System Performance in Metropolitan Areas: A Planning Guide, <https://coe-sufs.org/wordpress/ncfrp33/>
- G. Dalla Chiara & A. Goodchild (2020) *Do commercial vehicles cruise for parking?*, Transport policy, <https://doi.org/10.1016/j.tranpol.2020.06.013>
- G. Dalla Chiara, A. Alho, C. Cheng, M. Ben-Akiva, L. Cheah (2020) *Exploring Benefits of Cargo-Cycles versus Trucks for Urban Parcel Delivery under Different Demand Scenarios*, Transportation Research Records, 2674(5):553-562. Doi: [10.1177/0361198120917162](https://doi.org/10.1177/0361198120917162)
- Urban Freight Lab (2020), *Cargo E-Bike Delivery Pilot Test in Seattle* <https://depts.washington.edu/sctlctr/research/publications/cargo-e-bike-delivery-pilot-test-seattle>