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

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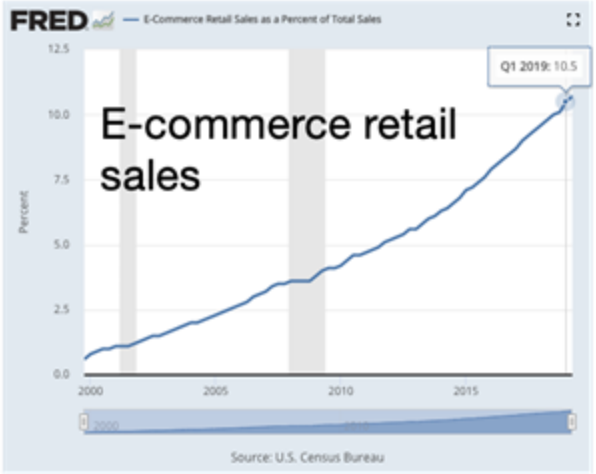
- Delivery challenges in urban areas
- Intelligent parking systems
- OpenPark: a real-time curb availability information system
- Experimental design & data collection
- Results

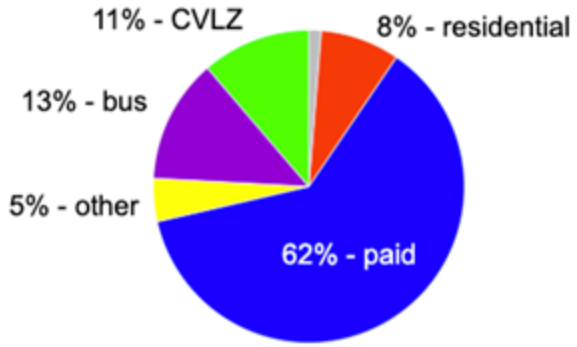
Delivering in urban areas is increasingly challenging

Freight parking demand



U.S. E-commerce retail sales represents 11.2 % of total sales (U.S. Census Bureau, 2019)

Freight parking supply



11% of allocated curb-space in Seattle is dedicated to commercial vehicles

(Seattle DOT, 2019)

Cruising for parking

Parking demand → 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 → 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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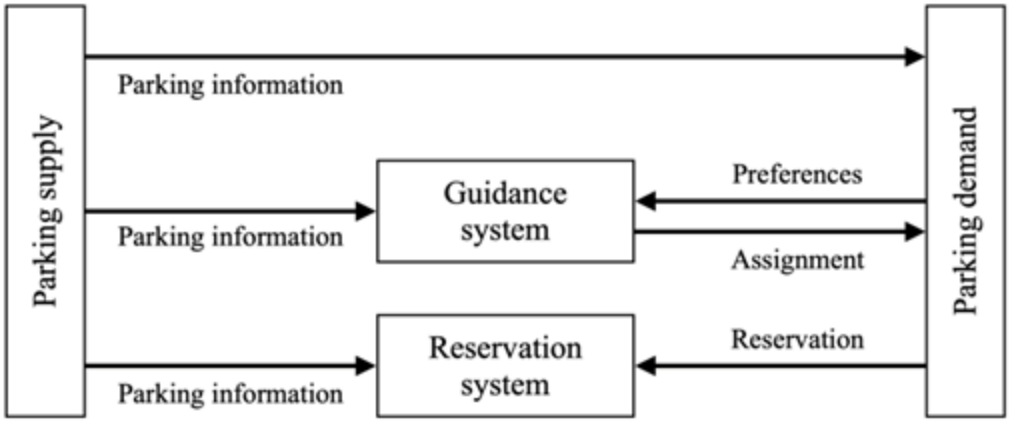
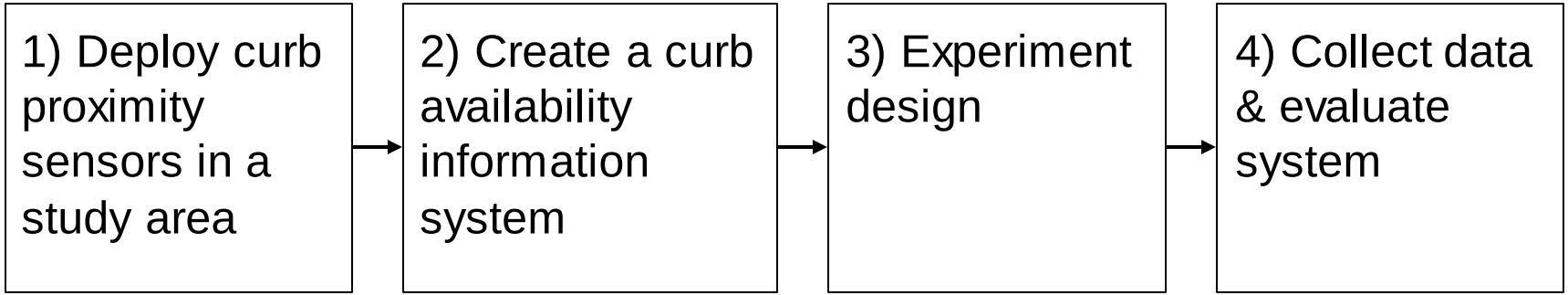
Intelligent parking systems

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?

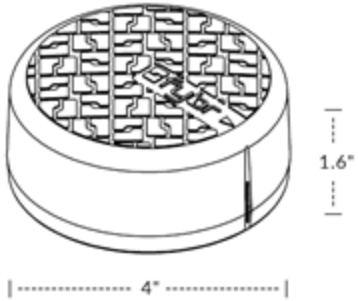
Methodology



OpenPark

Study area

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



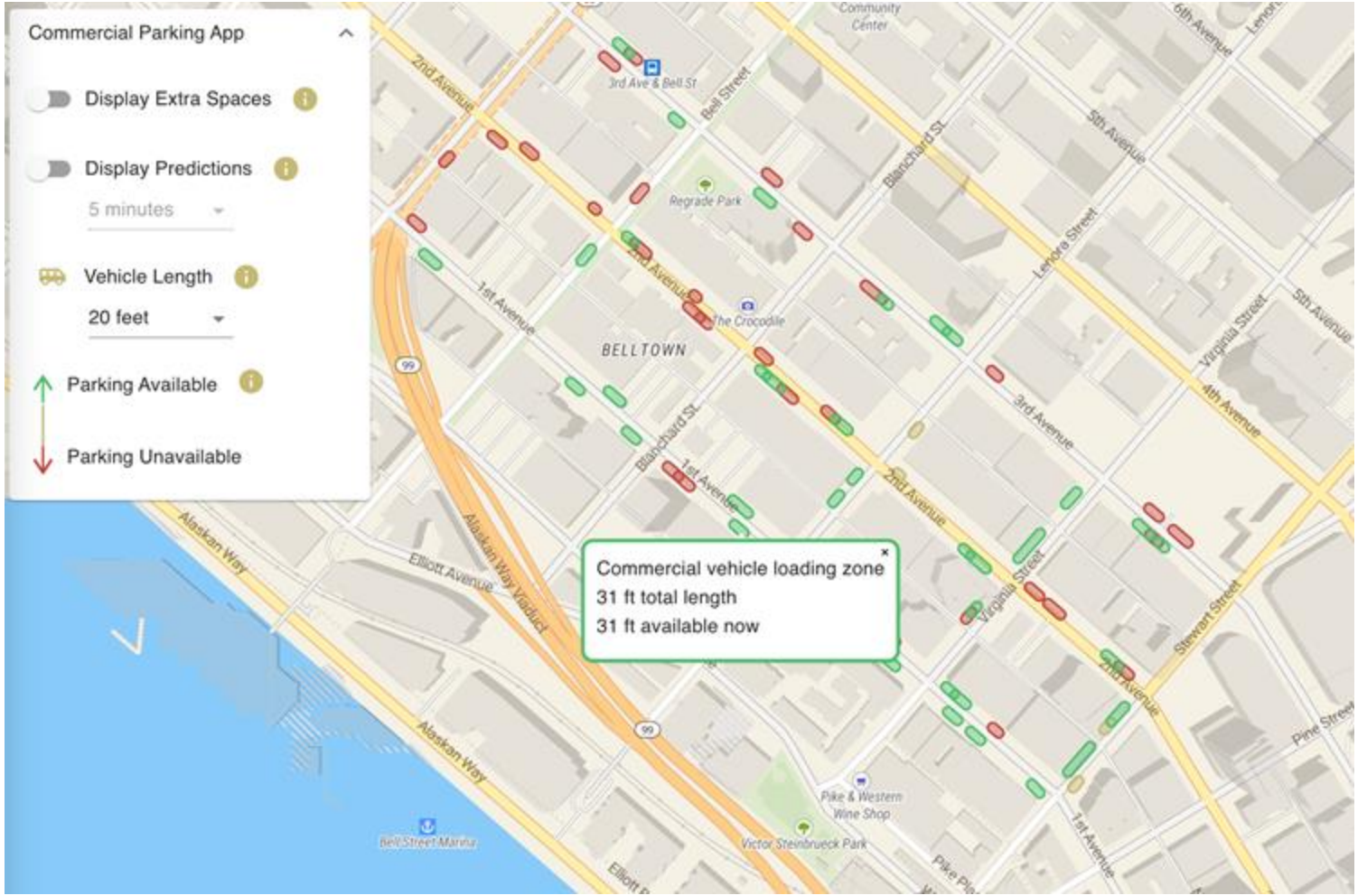
Sensor

Deployment

Gateway

Open park

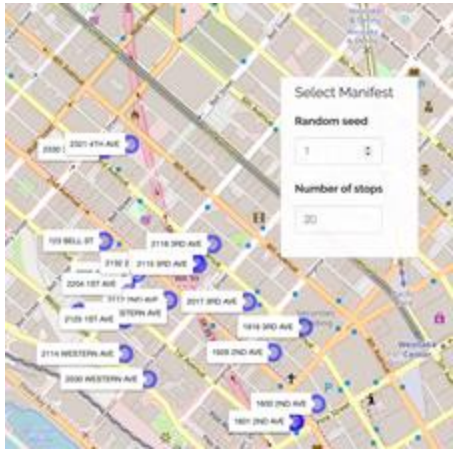
Real time & predicted parking occupancy of CVLZs and PLZs



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

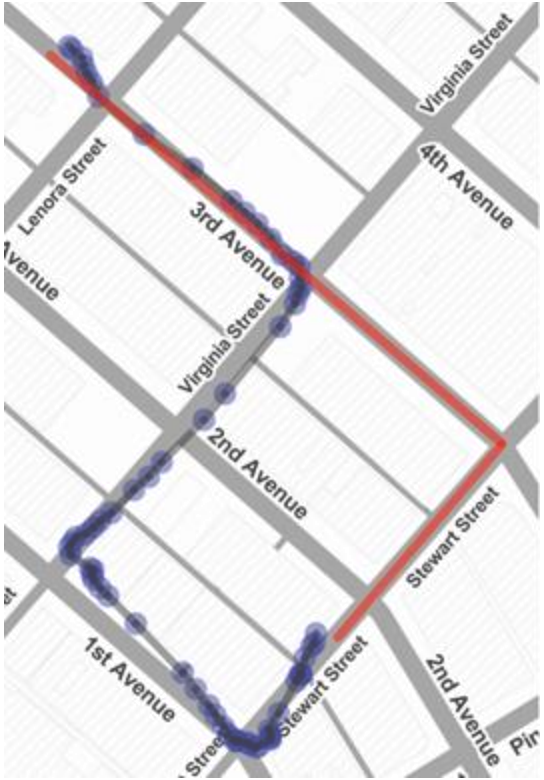
Observers rode along with drivers and collected GPS data

Performance metrics

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

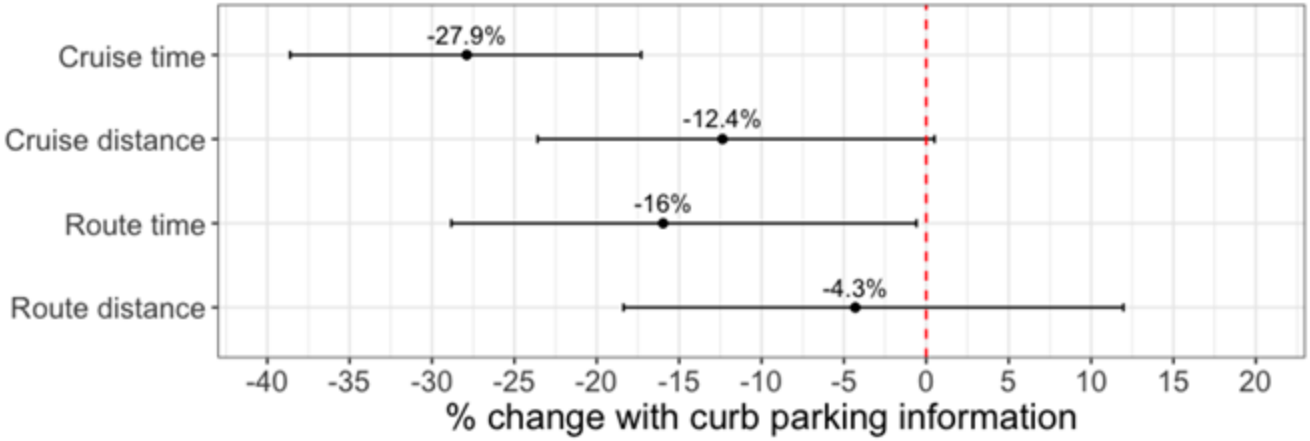
Performed

- 33 routes
- 495 deliveries
- 177 trips

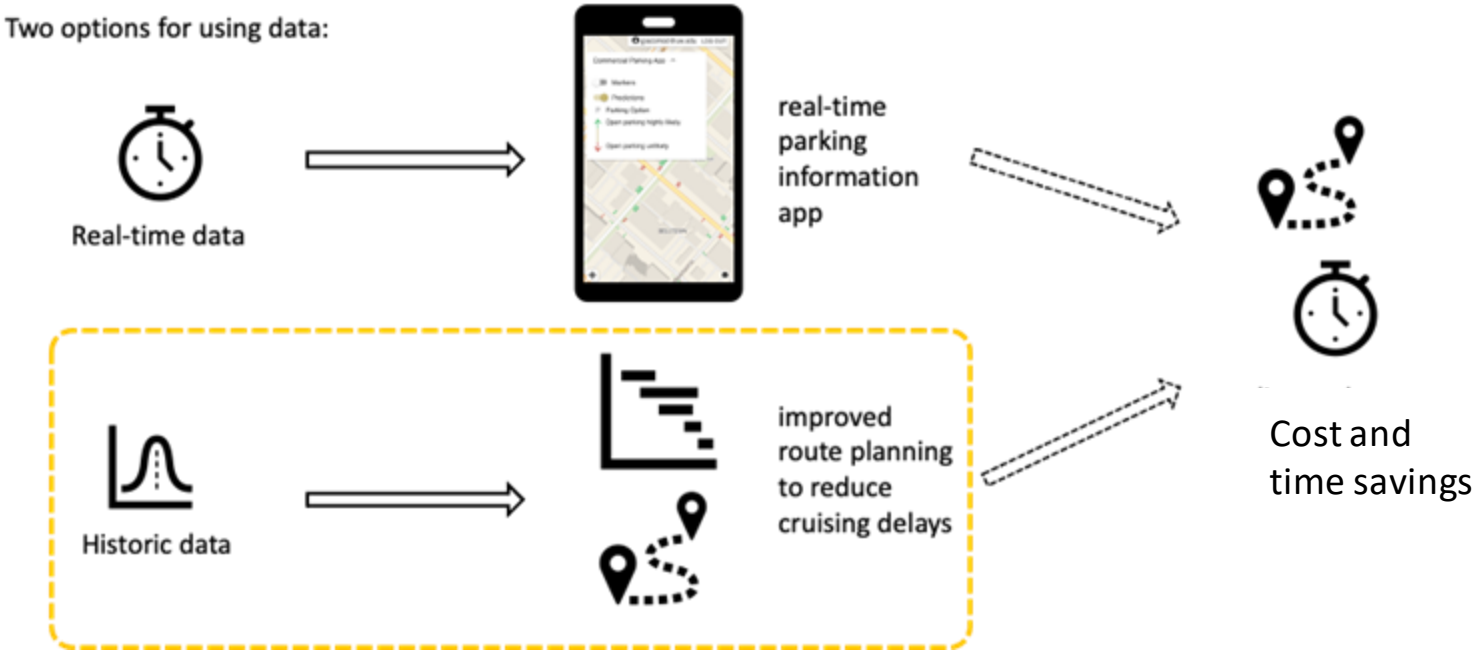


Results

- 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

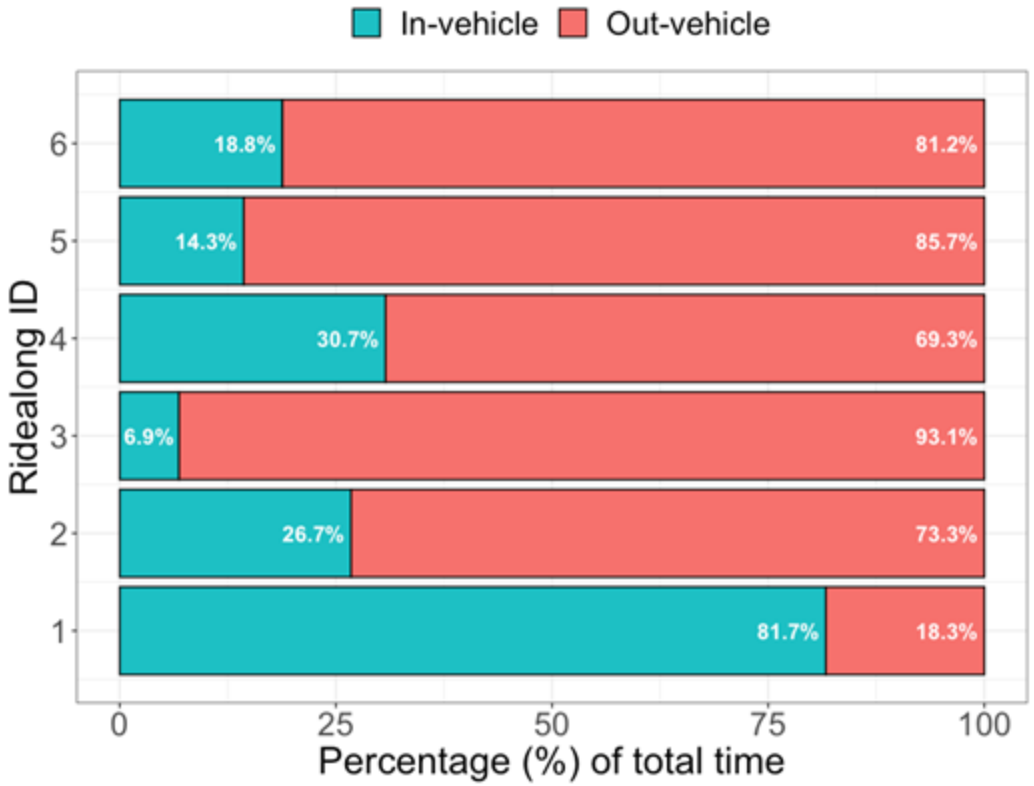

Two options for using data:
Real-time data
real-time parking information app
Historic data
improved route planning to reduce cruising delays
Cost and time savings

Thank you!

Giacomo Dalla Chiara (giacomod@uw.edu)

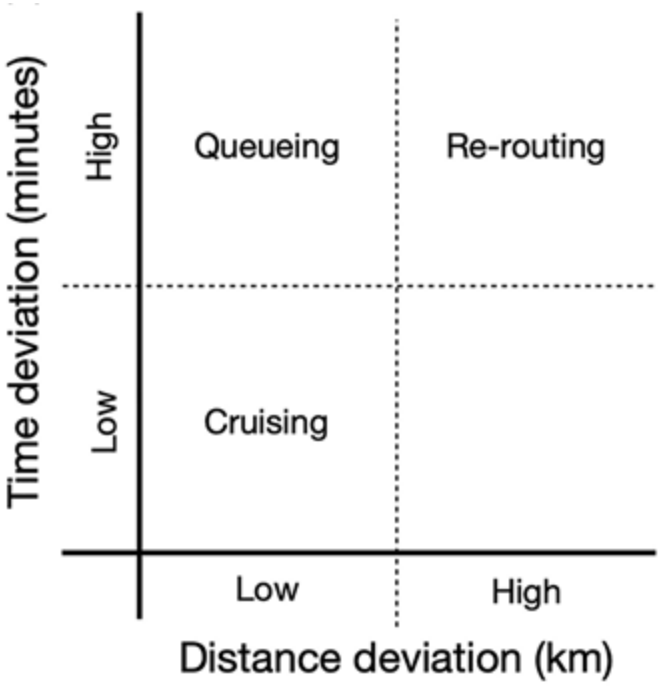
→ Can **parking availability information** reduce delivery vehicles cruising for parking and improve delivery efficiency?

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



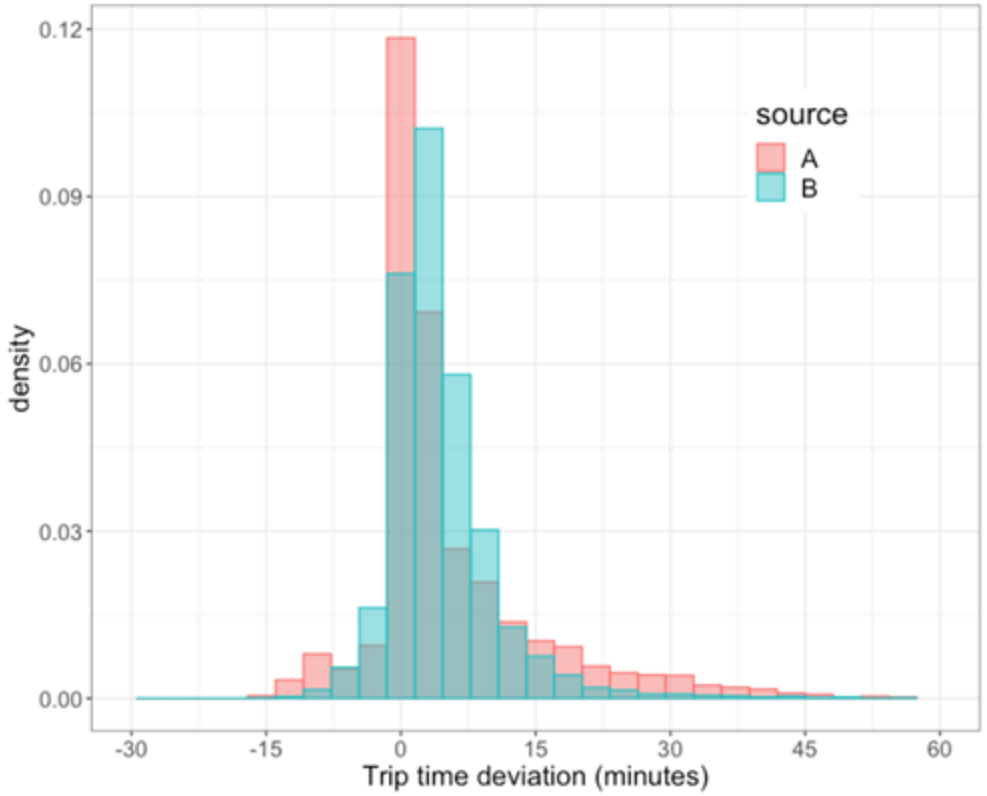
G. Dalla Chiara et al. (2021) *Understanding Urban Commercial Vehicle Driver Behaviors and Decision Making, TRR*

Commercial vehicle parking behaviors



G. Dalla Chiara et al. (2020) *Do commercial vehicles cruise for parking?, Transport Policy*

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.

G. Dalla Chiara & A. Goodchild (2020) *Do commercial vehicles cruise for parking?*

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)

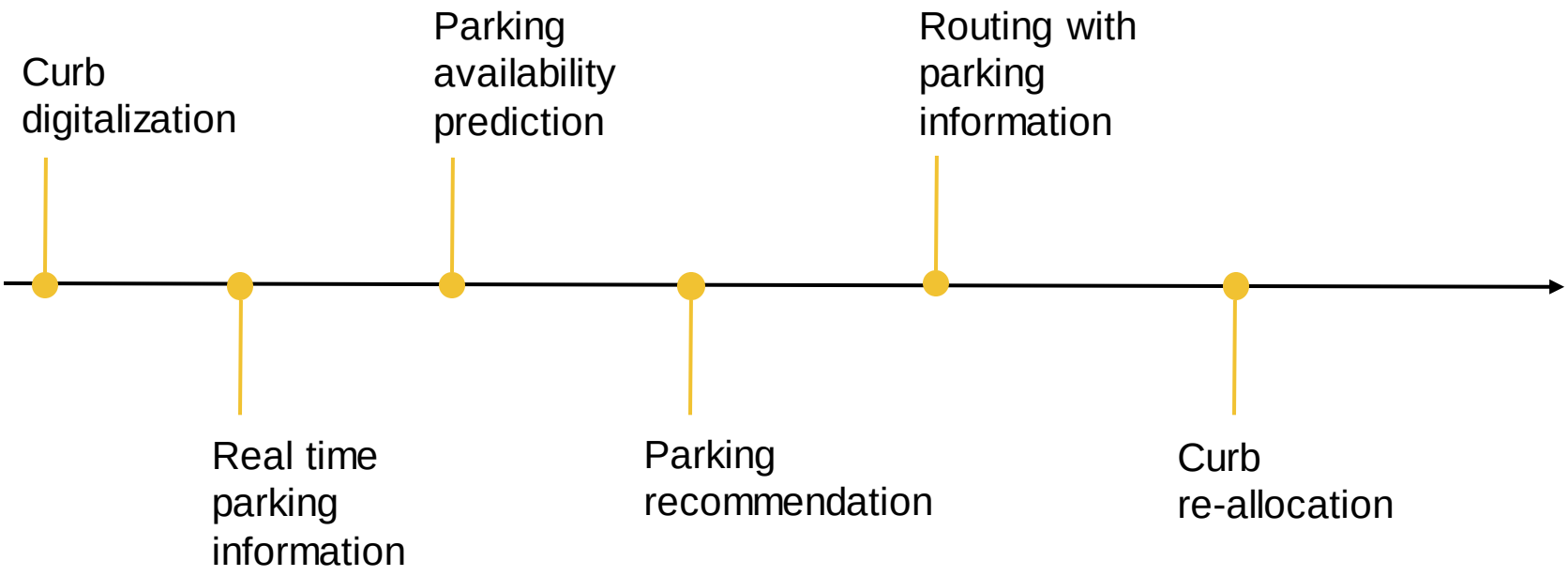
* % of unauthorised parking

Hypotheses

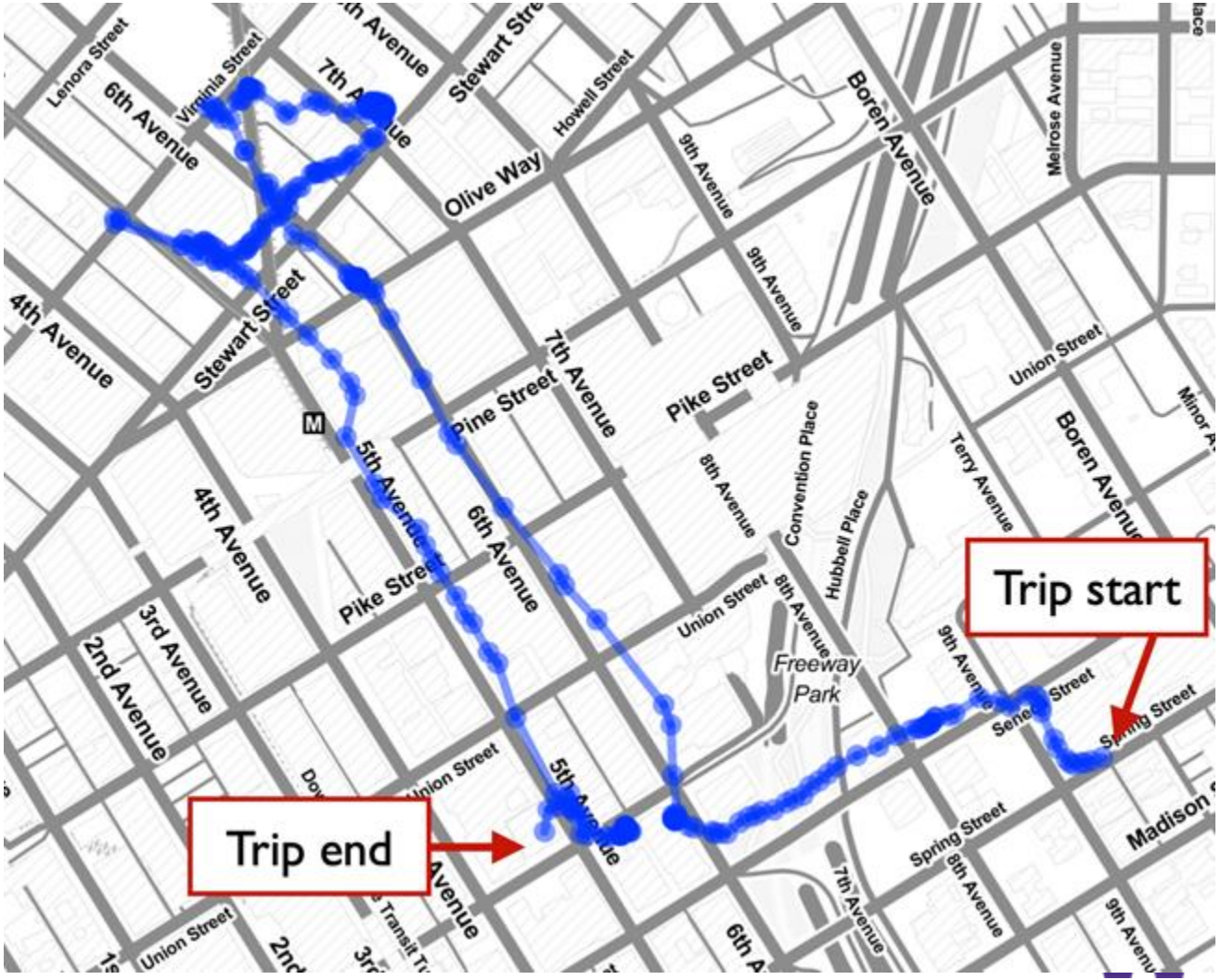
Performance metrics:

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

Roadmap


Curb digitalization
Real time parking information
Parking availability prediction
Parking recommendation
Routing with parking information
Curb re-allocation

Re-routing


Trip start
Trip end
Olive Way
Stewart Street
Pine Street
Pike Street
Union Street
Spring Street
Freeway Park
Convention Place
Hubbell Place
Terry Avenue
Boren Avenue
Howell Street
Melrose Avenue
Lenora Street
Virginia Street
4th Avenue
5th Avenue
6th Avenue
7th Avenue
8th Avenue
9th Avenue
2nd Avenue
3rd Avenue

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