

# Doing things with particle filters

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July 28, 2020

Hello ...

## Introduction

- the problem of predicting bus arrival - it needs to use real-time traffic information [1]
- however, many deployed methods are either specific to a provider/city, or don't make use of real-time data (only vehicle position and/or arrival delays, e.g., in Auckland)
- since the only logical source of "traffic data" in this setting is the transit vehicles themselves, makes sense to develop framework that uses them to estimate real-time network state [2]
- in this example, particle filter is used to obtain a sample of points from the arrival time distribution - many many points, which cannot possibly be distributed or stored efficiently
- we propose a method of reducing this to a simple discrete CDF of arrival time (in minutes)

## Background

Before describing the process of obtaining arrival time distributions, we must first define the framework with which we obtain vehicle and network state estimates. [2] present a process for constructing a transit road network from raw GTFS data.

### A transit road network

- information about GTFS
- the concept of converting it into a network (as per [2])
- end product is real-time estimates of traffic state

### Estimating network and vehicle state using particle filtering

- particle filter on vehicle state
- used to estimate vehicle speed, position
- obtain distribution of travel times for each vehicle along each road

## Predicting arrival time

### Particle filter etas

- use particle filter and network state to obtain ETA estimates for each particle/stop

- include dwell time uncertainties, etc
- result is a distribution estimated by  $N$  particles

## Simplified ETA CDF

- round to minutes
- compute the CDF by definition “number of particles arriving within  $x$  minutes”

## Journey planning applications

- CDF makes it possible to answer many (often complex) journey planning questions
- $P(\text{catch})$
- $P(\text{arrive on time})$
- $P(\text{transfer})$
- this is a simple computation - can be done client side (i.e., on a user’s phone) by passing CDF (small size, as e.g., JSON)

## Discussion

- what this means
- how this makes JP more accessible

## Future Work

- automated route selection
- improved particle filter
- improved network construction
- improved network state forecasts

## Conclusion

- simple conclusion of the paper

## References

- [1] CITATION NEEDED. *Missing citations*, 2020.
- [2] ELLIOTT, T., AND LUMLEY, T. Modelling the travel time of transit vehicles in real-time through a GTFS-based road network using GPS vehicle locations. *Australian & New Zealand Journal of Statistics* 62, 2 (2020).