Cycle Networks — Finding the Missing Links

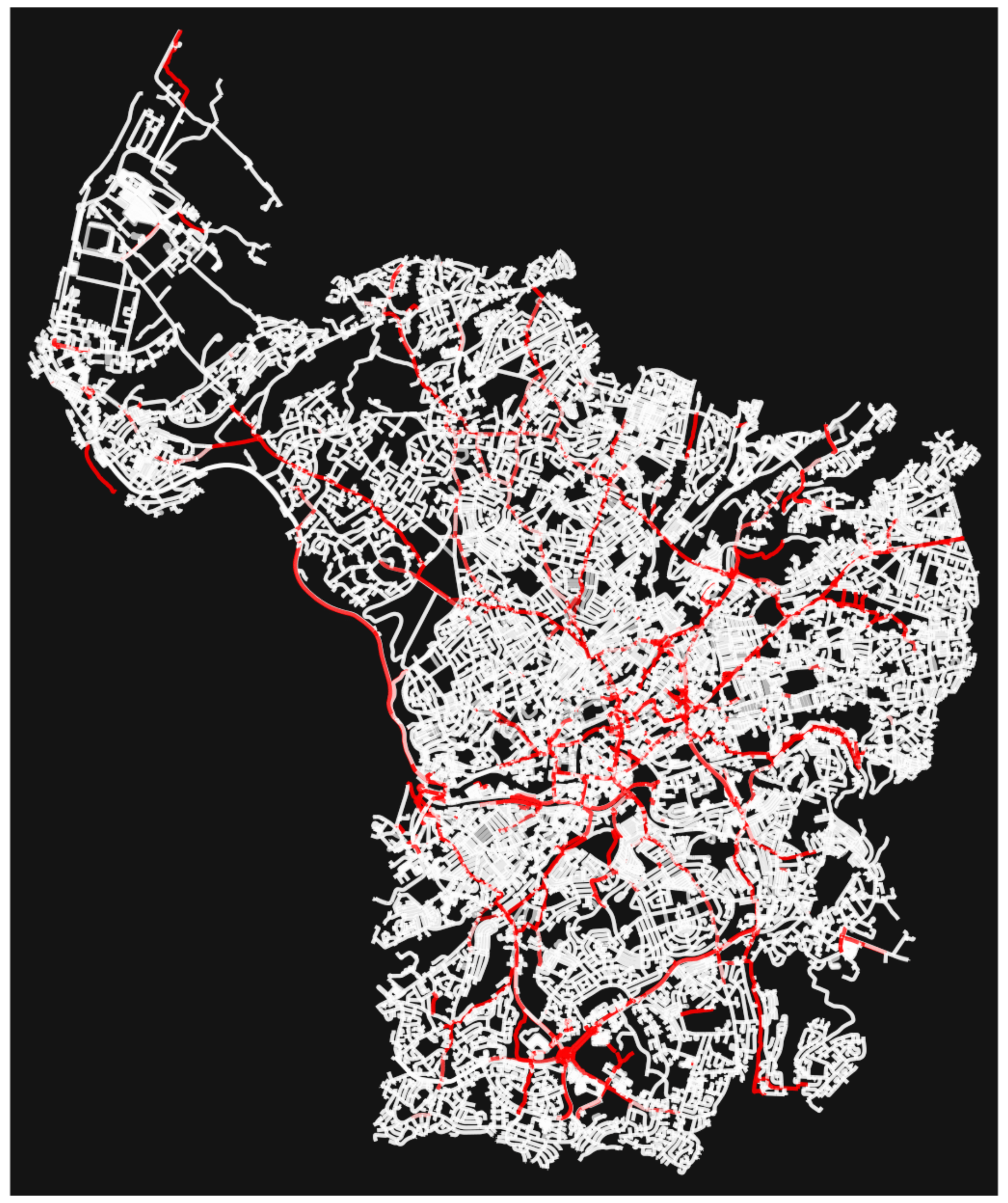
Max Oblein Supervised by Prof R. E. Wilson
mo17165@bristol.ac.uk

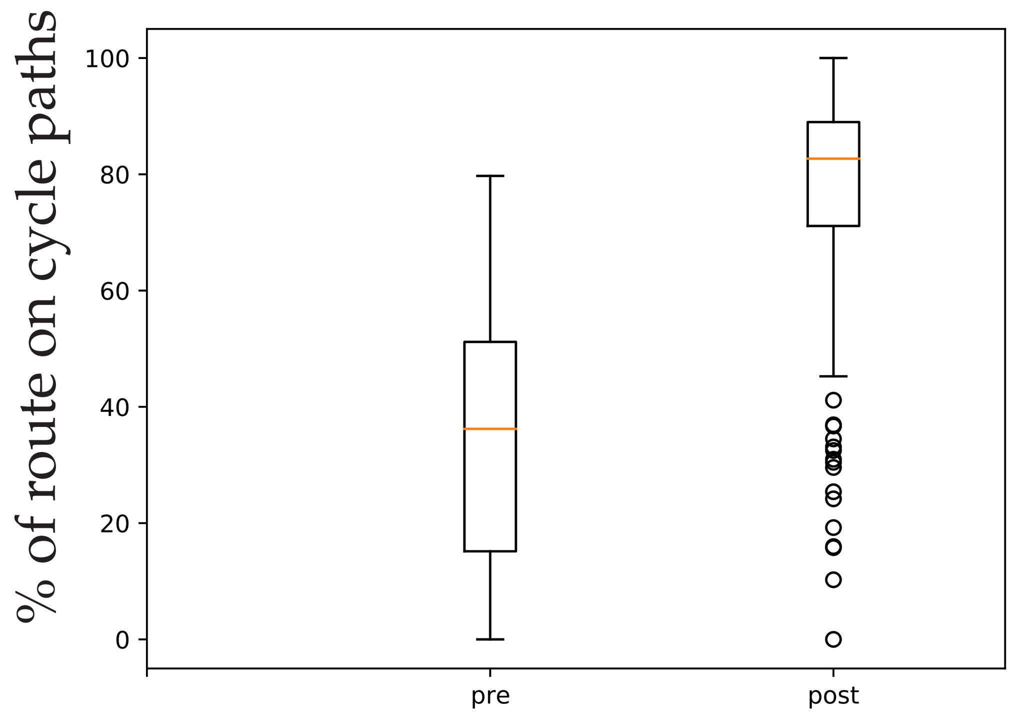
Abstract

Cycling is becoming increasingly more popular as a means of transport around large cities [1]. Research suggests that increased provision of cycling infrastructure is correlated with increased numbers of cyclists in a city [2].
This project asks three questions:

- Can a simple model of propensity to cycle give a good approximation of cyclist route choice?
- Can we use a simple heuristic to inform cycle network upgrades in a given city?
- How close does the heuristic approach come to formal optimal network design?

Bristol Street Network Upgrade





- We have doubled the amount of cycling infrastructure on the Bristol network.
- The upgrade heuristic strives to create a connected cycle network.
- Upgraded network: average cyclist spends $> 80\%$ of route on cycling infrastructure.

Methods

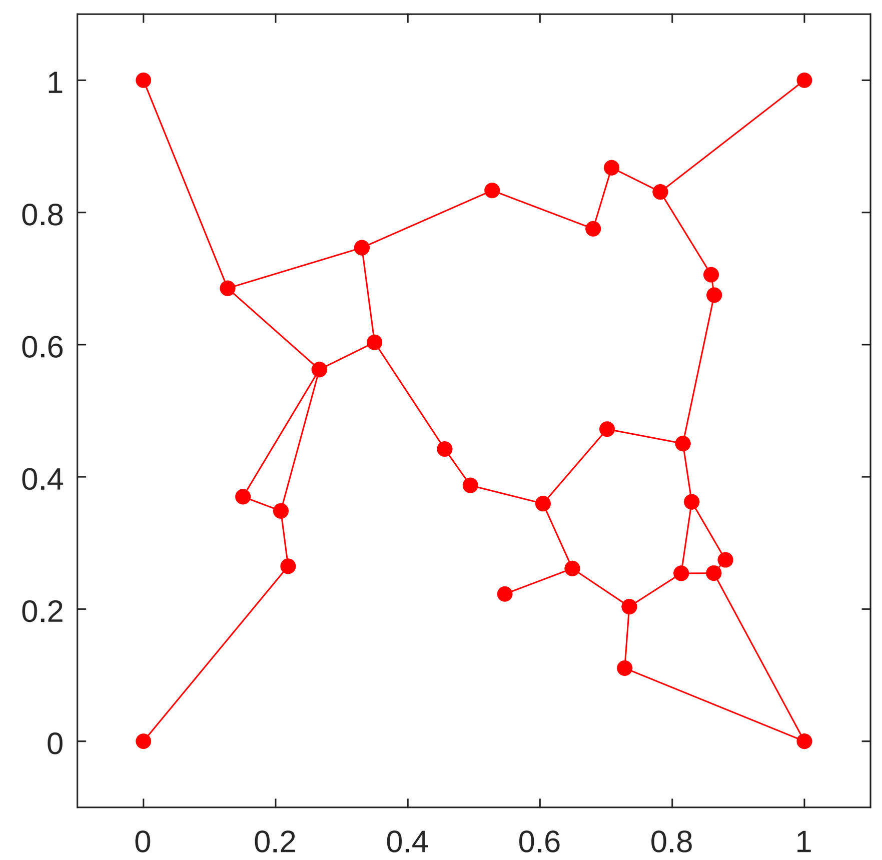
Cyclist route choice is modelled by a single parameter ω_k, their propensity to cycle, the edges in the street network then have perceived length

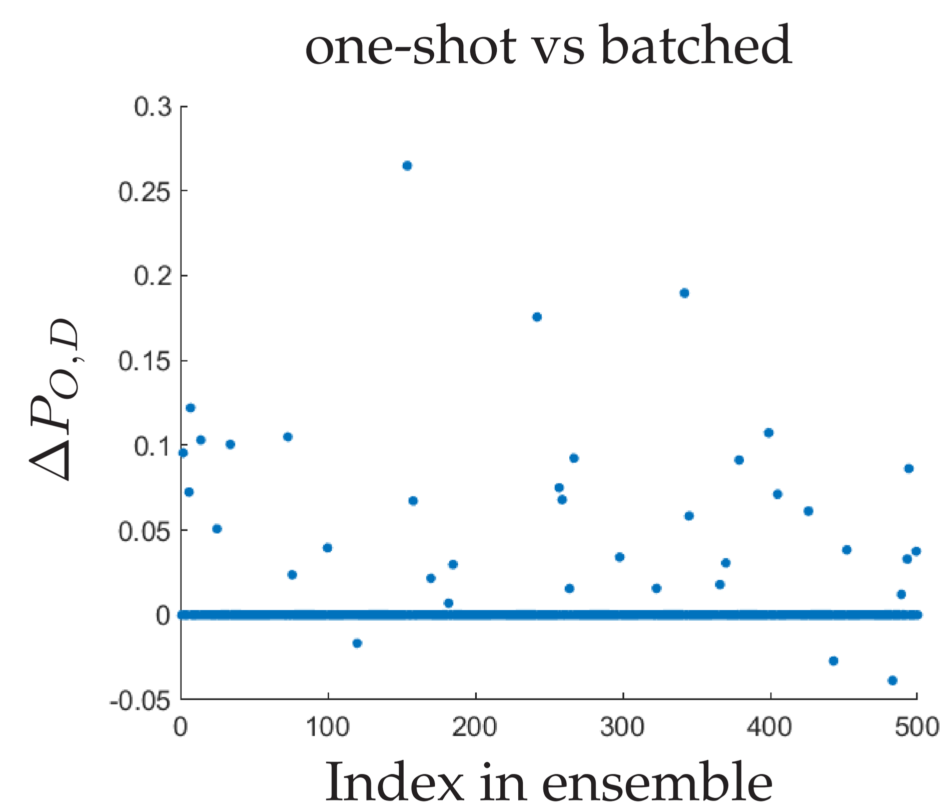
$$\hat{l}_{i,j} = l_{i,j}(1 + \omega_k p_{i,j}).$$

The network is then upgraded in the following steps:

1. Load network with cycling demand by generating OD pairs.
2. Calculate shortest routes according to perceived length.
3. Calculate edge flows corresponding to how many cyclists use each edge.
4. Upgrade the edges with the highest flow that currently have no infrastructure until upgrade budget L is reached.

Beta skeleton experiments





- Random networks generated using beta skeletons.
- Over an ensemble of random beta skeletons batched almost always the same or better than one-shot.

References

[1] C. Allan. Cycling UK's cycling statistics. `https://www.cyclinguk.org/statistics`. Accessed 2020-12-02.

[2] J. Dill and T. Carr. Bicycle commuting and facilities in major US cities: if you build them, commuters will use them. *Transp. Res. Rec.*, 1828(1):116–123, 2003.

Key Conclusions

We are able to answer the research questions proposed in the abstract:

- A simple one parameter model for propensity to cycle is enough to effectively model cyclist route choice on journeys within a city.
- Our heuristic approach informs cycle network design in a way that prioritises connected cycle paths, ultimately yielding better cyclist satisfaction.
- It can be shown that in some cases our heuristic can, in fact, yield optimal network design and as such is a great starting point for cycle network planning.