Modelling an electricity price and journey time trade-off routing decision for electric vehicles

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1. Background

The increasing adaptation of electric vehicles demands charging infrastructures and electric vehicle routing policies over a road network which avoid congestion at charging stations as much as possible.

An efficient allocation of electric vehicles over the different charging stations in a road network is important since charging a car takes significantly longer than refuelling, which makes congestion more likely to occur.

2. Decision models and trade-offs

MAX A greedy decision strategy where the next road segment with the highest expected utility is traversed.

IARS A decision strategy which follows from the intention aware routing system proposed by de Weerdt et al. [1]

A gamma parameter is used to express the drivers preference towards time. This parameters drives the tradeoff between journey time and money spent.

Utility = $\gamma \cdot$ Normalised journey time + (1 - γ) $\cdot$ Normalised money spent

When presented with the choice of several charging stations which each charge a certain price for electricity, how can we best model the choice of which station to go to?

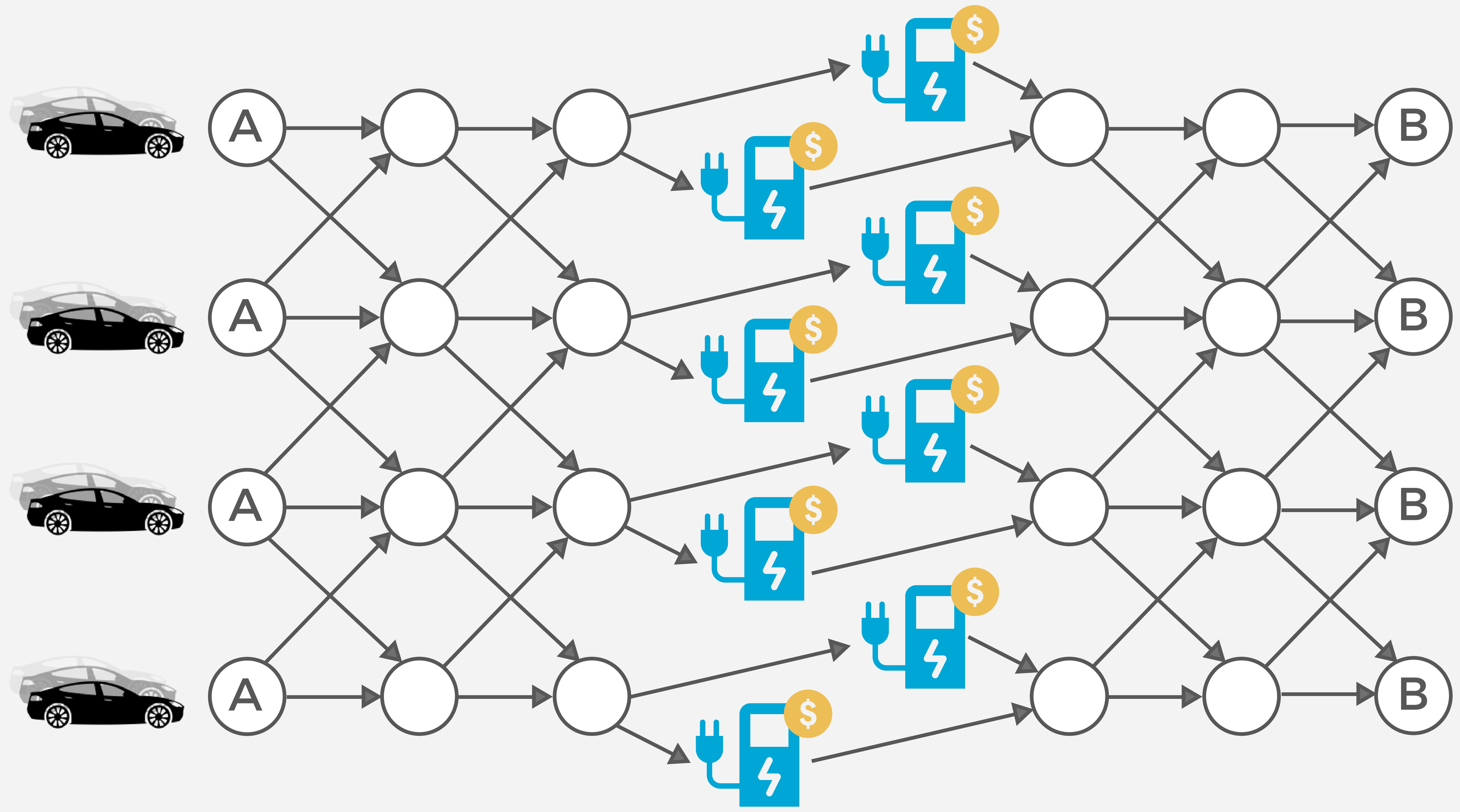

Figure 1: Grid road network with en-route charging stations

3. Experiments and results

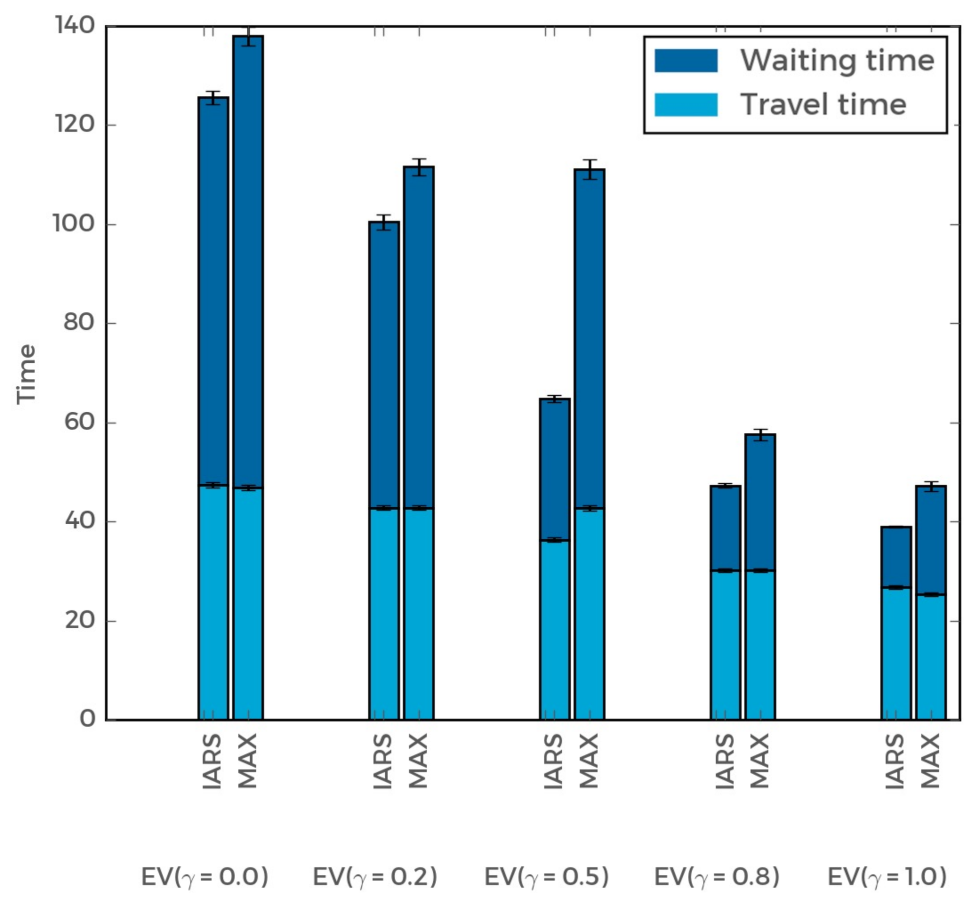

Figure 2: Journey time comparison for different vehicle types on the grid road

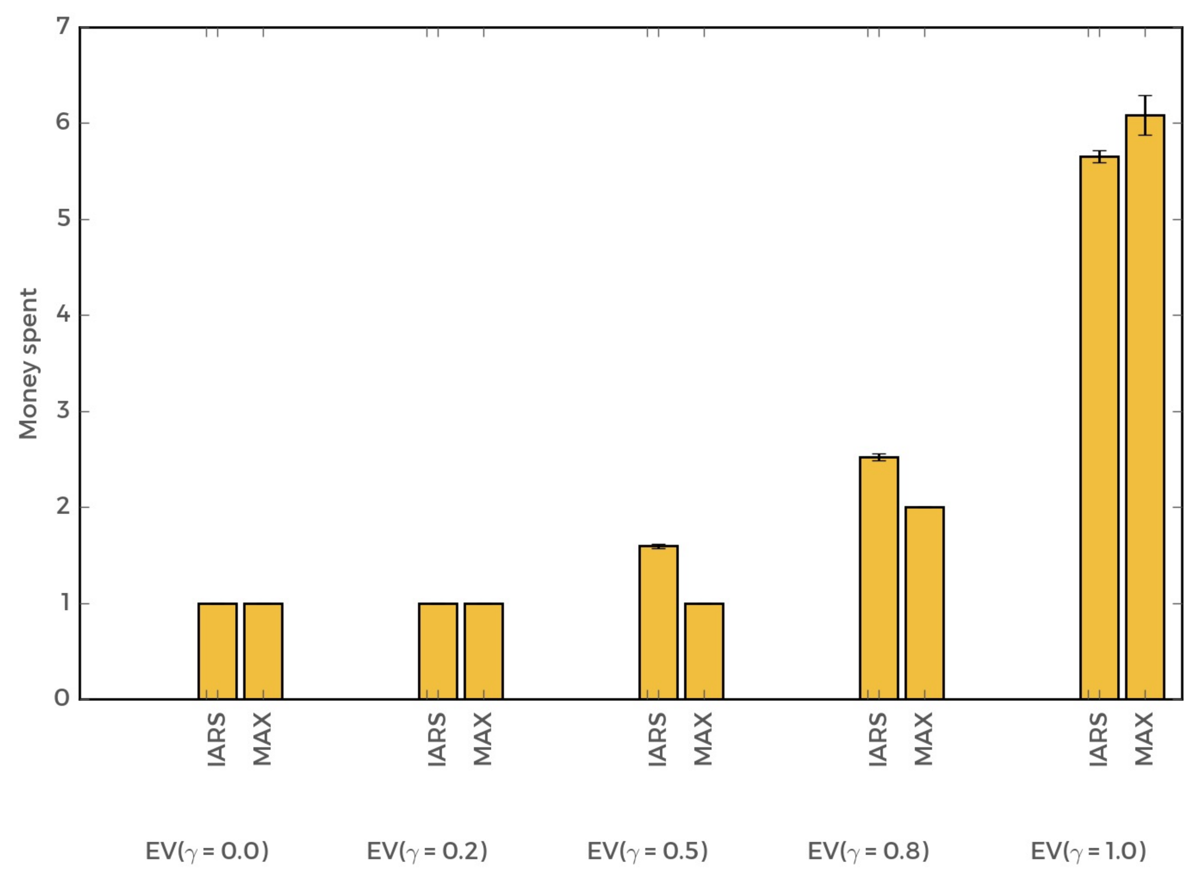

Figure 3: Money spent comparison for different vehicle types on the grid road network

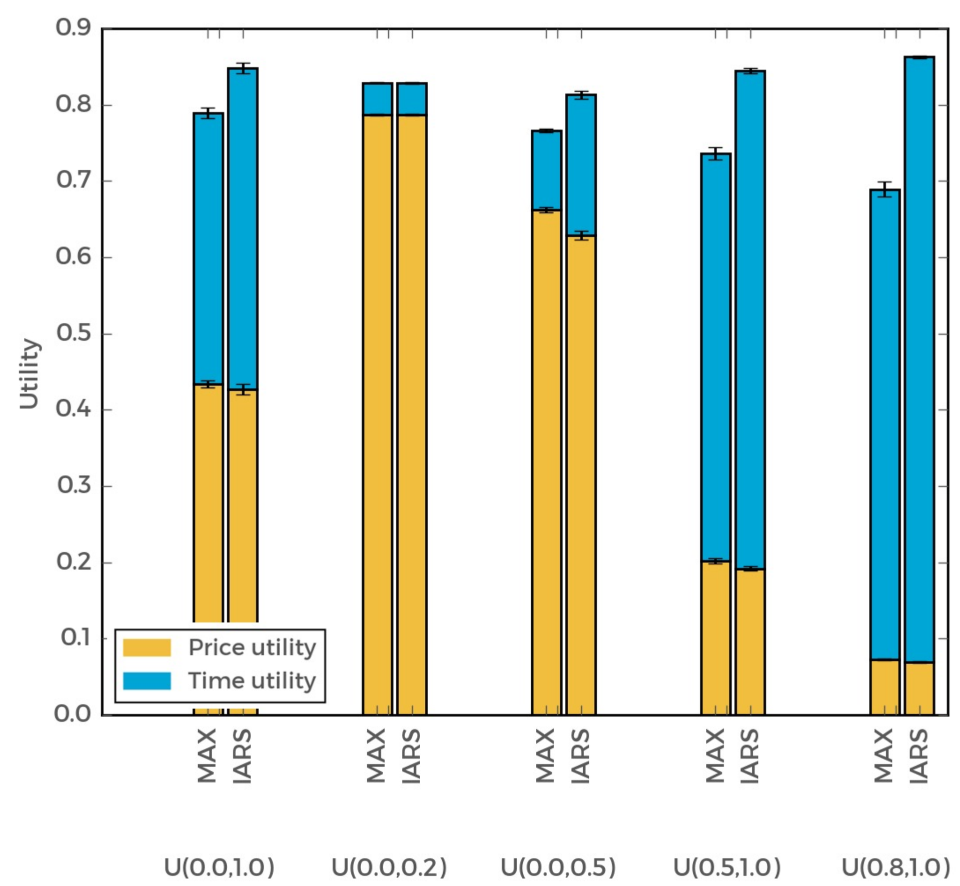

Figure 4: Overall performance of 100 vehicles with a random gamma drawn from U(a, b) on the grid road network

4. Conclusions

- Even after including a price factor, IARS still results in the best average utility.
- IARS translates driver preferences more accurately given the gamma parameter than MAX.
- The advantage IARS has over MAX depends on the type of drivers in the population of vehicles

[1] Mathijs M De Weerdt, Sebastian Stein, Enrico H Gerd-ing, Valentin Robu, and Nicholas R Jennings. Intention-aware routing of electric vehicles. IEEE Transactionson Intelligent Transportation Systems, 17(5):1472–1482, 2015.