The Overview of the thesis

Intention-Aware Routing of Electric Vehicles

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Introduction

This paper introduces an intention-aware routing system (IARS) for electric vehicles. This system enables vehicles to compute a routing policy that minimizes their expected journey time while considering the intentions of other vehicles. Considering that electric vehicles may need to recharge en route and face potentially significant queuing times if other vehicles choose the same charging stations. To address this, the computed routing policy takes into consideration predicted queuing times at the stations, which are derived from the current intentions of other electric vehicles.

Hypothesis and limits

o Hypothesis:

- A battery will always be fully charged at a station
- Each station has a fixed capacity which represents the maximum number of vehicles that can charge simultaneously.

o Limits:

- The number of the charging stations between the starting point and the destination

Used approach

The researchers proposed an Intention-Aware Routing System (IARS). This system communicates its intentions, relevant information about its planned arrival times at charging stations, to a central system. Internally, each vehicle computes a routing policy, which takes into account uncertainty about road conditions, waiting times and which charging stations may be used. Intentions are then derived from this policy and constitute probabilistic information about which stations the EV could visit and when, thereby allowing the centralized component of the system to accurately predict congestion (and thus waiting times) at those stations. This information is then fed back to the EV driver’s navigation system, which can automatically adjust its routing policy accordingly, and send updated intentions back to the central system.

Results

The efficacy of IARS is demonstrated through simulations using realistic settings based on real data from The Netherlands, including charging station locations, road networks, historical travel times, and journey origin–destination pairs. In these settings, IARS is compared with a number of state-of-the-art benchmark routing algorithms and achieves significantly lower average journey times. In some cases, IARS leads to an over 80% improvement in waiting times at charging stations and a more than 50% reduction in overall journey times.

Advantages and disadvantages

Advantage:

- The advantage of their approach is that it captures realistic situations where travel time is uncertain, and a delay on one part of the route can affect the travel time elsewhere, possibly making an alternative route more attractive.

Disadvantage:

- A largely unsolved challenge for reservation-based approaches is dealing with uncertain driving times, as delays could necessitate re-scheduling or even re-routing to a different charging station, invalidating the optimal schedule and existing reservations.

Conclusion

The main contribution of this paper is the concept of an intention-aware routing system (IARS) to coordinate the enroute charging of electric vehicles. The experiments show that individual drivers are better off using the navigation advice from IARS than with classic route guidance systems.

Reference

Weerdt, M., Stein, S., Gerding, E., Robu, V. and Jennings, N.R. (2015) 《*Intention-aware routing of electric vehicles*》. IEEE Transactions on Intelligent Transportation Systems, 17 (5), 1472-1482. (doi:10.1109/TITS.2015.2506900).