Poster: A Magnetic Fingerprint-based Automobile Position Tracking using Smartphones

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ABSTRACT

The state-of-the-art navigation frequently fails to provide precise outdoor localization especially in urban areas due to GPS errors. Conventional approaches tracking vehicle positions have used the particle filter algorithm, and we focus on magnetic fingerprint features for increasing performance of the algorithm as landmarks. We investigated the magnetic features in two conditions such as in-vehicle and at an intersection. More diverse traffic environments and an effective design of the particle filter algorithm will be complemented in the future research. We expect these magnetic fingerprints significantly improve outdoor localization algorithms especially in urban areas.

1. MAGNETIC FINGERPRINT-BASED AUTOMOBILE LOCALIZATION

Precise tracking of a vehicle position is important in terms of safety. A driver who is on a wrong lane may try dangerous lane changes (e.g., exit from a freeway, get in the correct lane by makeing a turn), which may cause car accidents. The state-of-the-art navigation provides automobile positions, but the lane level accuracy of vehicle positions is hard to achieve due to the GPS errors. The GPS errors sometimes get worse over 15 meters especially in obstructed urban environments. To improve performance of outdoor localization, we focus on magnetic fingerprint features for map-matching to improve the accuracy of tracking performance. Conventional approaches have used particle filter algorithm which recursively re-samples a set of particles and converges to true vehicle position. Our approach is to use the magnetic fingerprint features in updating the vehicle position as landmarks, which reduce estimation errors in the particle filter algorithm. For tracking vehicle positions using smartphones, two steps are needed. First, smart-phone position in vehicle is tracked by using the magnetic fingerprints in a vehicle. There is no significant difference in terms of engine activation as shown in Fig.1-(a)(b). And then, rapid change of the magnetic fingerprints on the road can be used as distinct landmarks. At the intersection, there is a significant difference as shown in Fig.1-(c).

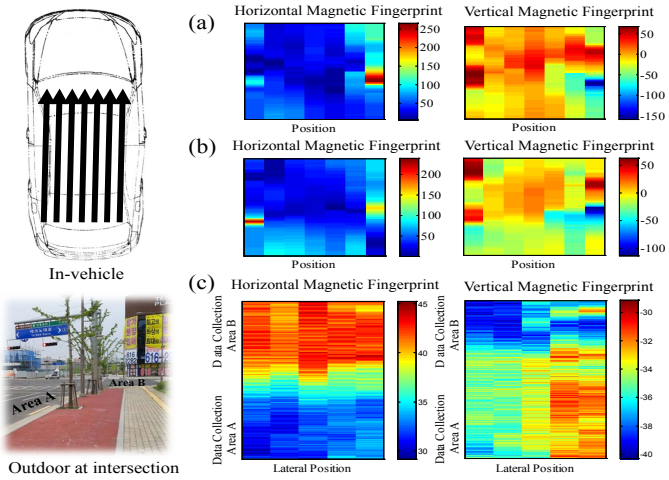

Figure 1: Magnetic fingerprint;(a) In-vehicle HV features when engine is turned off, (b) In-vehicle HV features when engine is turned on, (c) Outdoor HV features at intersection

2. CONCLUSION AND FUTURE WORK

Magnetic fingerprint-based automobile positioning can be used for improving tracking algorithm such as particle filter since magnetic fingerprint features can be distinct landmarks. We tested in-vehicle and outdoor conditions to extract the magnetic features. We will collaborate with the University of Michigan for designing a precise outdoor vehicle tracking algorithm using magnetic fingerprints. Designing particle filter consisting of magnetic fingerprint features and how to use the features in crowd-sourcing technique for updating dynamic traffic environments are main future research topics. We expect that the magnetic fingerprints are effective landmarks for compensating the GPS error problem since there are many infrastructures such as electric poles, traffic lights or iron fence in urban areas.

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