WiP Abstract: GPS-less Localization System in Vehicular Networks Using Dedicated Short Range Communication

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***Abstract*—Vehicular localization plays an important role to enable safety and traffic flow control in intelligent transportation systems (ITS). Global positioning system (GPS) is generally used to localize a vehicle, but it is challenging to obtain the accurate location when the GPS signal is blocked from the satellites or corrupted by the multipath propagation. In this work, we present a GPS-less localization system using dedicated short range communication (DSRC). The primary objective is to accurately localize a vehicle without GPS. To this end, we propose a localization scheme using infrastructure-to-vehicle (I2V) and vehicle-to-vehicle (V2V) communications.**

Keywords- vehicular localization;

I. Introduction

The recent advances in intelligent transportation systems (ITS) make people envision various applications such as the collision avoidance system, the collision warning system, and the intelligent traffic flow control while driving. These applications can be operated through dedicated short range communication (DSRC), which is one of the most promising wireless communications in vehicular networks. However, they require accurate vehicle localization for the best performance. Global positioning system (GPS) is generally employed for vehicle localization, but it has a low accuracy (i.e., 10 ~ 30m error), which is not appropriate for the above applications, due to the surrounding environment. Moreover, a vehicle cannot localize itself when the GPS signal is blocked (e.g., in a tunnel or underground). In order to mitigate those problems, we propose a GPS-less localization system using DSRC. To this end, a vehicle measures the distance between itself and a roadside unit (RSU) and its neighboring vehicles using time of arrival (ToA), which is a radio frequency ranging technique.

II. System Model

Every vehicle mounts an on-board unit (OBU) and RSUs are deployed on roadside as shown in Fig. 1. They periodically broadcast beacon messages and the messages from RSUs contain the RSUs' coordinates. Vehicles can measure the distance between vehicles or between a vehicle and RSU using the radio-frequency ranging techniques. Namely, the distance is measured through ToA which is the time taken by the radio signal (i.e., beacon message) to reach a receiver from the transmitter.

Vehicles measure the distance from each RSU and they can estimate their location based on the dotted circles in Fig. 1. To be specific, they can anticipate that they are within the area overlapped by two circles with the centers at different RSUs' coordinates because distance measurements using ToA result in errors of a few meters [1]. The estimated vehicle location is represented in Fig. 2. After that, the vehicles measure the distance from each neighboring vehicle and exchange their estimated location and measured distance via vehicle-to-vehicle (V2V) communication. Based on the above information, the vehicles can estimate the accurate locations.

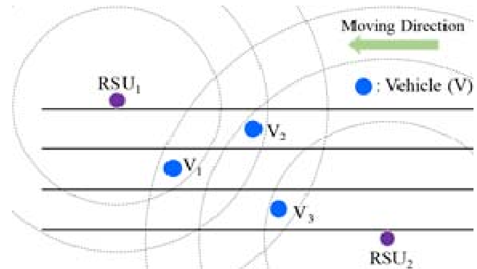

Figure 1. Measured distance from each RSU via ToA (a center of circle is RSU's coordinate and a radius is a measured distance)

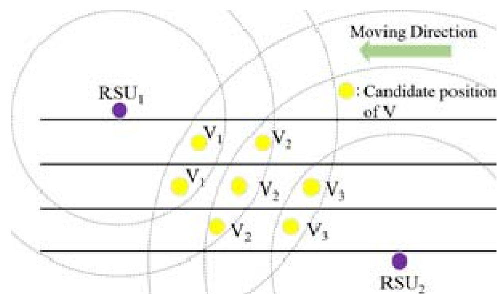

Figure 2. Estimated vehicle location through I2V communications

III. Conclusion

This system is expected to provide accurate localization in vehicular networks. Moreover, a vehicle can estimate its location regardless of the GPS signal state.

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References

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