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Vehicle Sensing and Localization in Vehicular Networks

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Abstract. In this paper, we provide a review of vehicle sensing and localization in autonomous driving. In autonomous driving, the significant and essential operation is accurate vehicular sensing. Vehicular sensing is the most demanding area of vehicular communications and has many envisioned applications in traffic safety and congestion avoidance. We begin by providing a brief overview of the Vehicular Ad Hoc Network (VANET) architecture, including its types. Additionally, we delve into in-vehicle sensors and their classification. The number of sensors in cars continues to grow, driven by their advantages in preventing injuries, enhancing driving performance, and supporting ubiquitous applications centered around vehicle sensing. We study and compare the current and existing techniques of localization (synchronous and asynchronous) and approaches for vehicle positioning, which is used for communication-based (e.g., GPS information) and reflection-based (e.g., RADAR Cameras). Also, we have also reviewed the vehicle-to-vehicle/infrastructure communications (V2X) with an emphasis on the 5G perspective.

Keywords: 5G Localization; Localization; VANET; Vehicle Sensing

1. Introduction

The vehicular ad-hoc network (VANET) is also known as the network on wheels, which is used to provide communication between vehicular nodes. The main objective of VANETs is to build an intelligent transportation system (ITS). It is basically a subset of a Mobile Ad Hoc Network (MANET) in which nodes will allow car-to-car (V2V) as well as car-to-infrastructure (V2I) communication. Vehicular Ad hoc Networks (VANETs) are an emerging and demanding paradigm in wireless networking that supports a variety of applications in safety, traffic efficiency, and entertainment (Singh, Rawat, and Bonnin, 2014). The IEEE committee has developed the IEEE 802.11p standard for VANET Safety-related applications in Intelligent Transportation Systems (ITS) (Abbasi and Khan, 2018).

The U.S. Federal Communications Commission (FCC) has allocated a spectrum bandwidth of 75 MHz with a frequency of 5.9 GHz for vehicular communication which is known as the Dedicated Short Range Communications (DSRCs), facilitating communication between Vehicle-to-Vehicle (V2V) and Vehicle-to-Infrastructure (V2I) systems. Faster communication and great safety between vehicles are said to be achieved by Dedicated Short Range Communication (DSRC)(Aziz *et al.*, 2022) In the past years, vehicular

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