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Advanced Integration of GNSS and External Sensors for Autonomous Mobility Applications

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Abstract

The need of accurate and reliable positioning, not only is essential for the autonomous mobility, but it is of paramount importance with the advent of new services and means for transportation systems. The more accurate and reliable the positioning information, the more stringent service it can support. Within this picture, Global Navigation Satellite Systems (GNSSs) are considered as the superior system able to provide accurate and global position, velocity and time. However, GNSS technology experiences its limitation due to the physical principle of satellite based position determination that highly depends on the conditions it is used in. As an example, urban areas are typical environments where the GNSS signals are attenuated, blocked or reflected by high buildings and other objects in the line of sight between the user and the satellite. Therefore, in order to meet the requirements demanded by Intelligent Transport System (ITS) services in such areas, more complex navigation unit must be adopted with the aim to enhances the performance in terms of positioning accuracy, reliability and continuity of the position. Coupling sensors that have complementary characteristics, consistently enhances the performance of the navigation system, limiting, at the same time, the weaknesses of each individual sensor.

In this context, this thesis aims at assessing the performance of multi-sensor navigation system, mainly addressing two different architectures of the hybridized receiver, i.e. tight and ultra tight integration. Data fusion is achieved integrating GNSS, Inertial Navigation System (INS), visual sensor and odometer. The performance of the navigation system is assessed in different scenarios, with the aim to demonstrate its effectiveness as well as its feasibility with respect to different classes of ITS services.