Background

Kapsch TrafficCom is an international supplier of technology, solutions and services for the Intelligent Transport Systems (ITS) market. We offer end2end solutions from a single source.

For Electronic Toll Collection (ETC) in free-flowing traffic, we take various base technologies and combine them into smart systems. These fully automated solutions help our customers implement systems that prevent congestion and reduce pollution. They also increase operating cost efficiency.

Satellite based tolling is on type of ETC which uses On-Board Unit (OBU) that has a built-in satellite tracker for distance-based tolling and a wireless module for data transfer communicate with the toll operator's back office while driving.

The CEN DSRC / GNSS hybrid OBUs are the in-vehicle parts of the Kapsch TrafficCom satellite tolling system that is designed to facilitate distance based road charging schemes.

Figure 1: Kapsch GNSS OBU TS3290

The latest Global Navigation Satellite System (GNSS) and GSM technology is combined into one compact unit that also contains a Dedicated Short Range Communication (DSRC) interface according to the CEN DSRC/EFC standards. This enables migration from, and interoperability with, existing DSRC based charging systems. The DSRC interface can also be used to communicate with the vehicle from mobile or fixed compliance checking facilities.

The distance based charging application is based on the concept where GNSS positions are collected and transferred to a host system via a GPRS communication link and where the actual charging transaction is performed in the central system. This concept allows for very flexible tariff and road segment schemes since no large amount of map data or algorithms needs to be downloaded to the OBU.

In many cases, the drivers do not want to have the OBU mounted in the vehicle. They are however often forced by law. It is therefore important that OBUs are able to operate standalone in a vehicle environment for a long period of time.

A satellite tolling system typically contains 30 000 to 2 000 000 OBUs. Keeping the cost for each OBU as low as possible is therefore of great importance. Finding a good balance between positioning accuracy and OBU cost is crucial.

Kapsch existing GNSS OBU, the TS3290/00A, relies on GPS for positioning. Single GNSS constellation performs sufficient in open sky and even in a semi-urban environment. However, in an urban or urban canyon, the positions accuracy decreases dramatically. Multi constellation GNSS receiver does increase the accuracy in these types of environments but is it enough?

Purpose

The purpose of the master thesis is to develop, implement and evaluate position accuracy enhanced by sensor fusion.

Goal

Develop a HW demonstrator which can be mounted in a vehicle to show what affect different type of sensors have on the positioning accuracy in various environments.

Implement and evaluate two (or more) different filtering techniques which combine at least GNSS position data and MEMS data. The implementation shall be done in a way that it is easy incorporate additional sensors.

Primary sensors to be used are GNSS and MEMS (gyro and accelerometer). Additional sensors to be used are barometer, magnetometer, map (or partial map), odometer and crowdsourcing (WiFi, BT, etc.).

Questions to be considered while doing the evaluation are:

- How much is the accuracy increased when adding a sensor?
- In what environment does the added sensor contribute most/least?
- Which filtering technique is best suited for an embedded system with limited processor and memory capacity?
- Which filtering technique is best suited for real time positioning accuracy improvement and which is more suited for post processing?
- Optional – What resolution and information is needed in the map material and what can be done to reduce the size, e.g. partial map coverage?
- Optional - Which filtering technique is best suited for a server application with large processing power and operating on “offline” data, i.e. the positioning accuracy improvement does not have to be done in real time?
- Optional – How can this be used in path prediction for a V2X application?

Details

The student(s) is qualified if it has successfully completed the Sensor Fusion course or equivalent. Programming skills (C, C++, Matlab) and knowledge of real time systems are meritorious. Qualifications shall be attached.

Number of students

Up to 2 students.

Contact

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