



Hochschule Karlsruhe

University of Applied science

Algorithm and Software Development of an OSM-Map Based Speed Limit Warning System

Introduction

Developing the speed limit warning system demanded working with and integrating several components, the Android GNSS sensor, Squarell bluetooth device, OSM data, CAN-Bus data and Extended Kalman Filter. The speed limit warning system developed, links real-time location data obtained from the GNSS sensor, and speed obtained with the help of the SQUARELL bluetooth device to a SQLite database that contain OSM file of Karlsruhe city.

Method

For the sake of brevity, in this work, as the system guiding equations are in a non-linear form, therefore the Extended Kalman Filter was used to estimate vehicle position, velocity, acceleration, yaw angle and yaw rate according to the following guiding equations:

$$N(k + \Delta k) = N(k) + [v \cos \gamma(k)] \Delta(k) + 1/2[-v \sin \gamma(k) \dot{\gamma}(k) + \dot{v} \cos \gamma(k)] \Delta k^2 \quad (1)$$

$$E(k + \Delta k) = E(k) + [v \sin \gamma(k)] \Delta(k) + 1/2[v \cos \gamma(k) \dot{\gamma}(k) + \dot{v} \sin \gamma(k)] \Delta k^2 \quad (2)$$

$$v(k + \Delta k) = v(k) + \dot{v} \Delta k \quad (3)$$

$$\dot{v}(k + \Delta k) = \dot{v} \quad (4)$$

$$\gamma(k + \Delta k) = \gamma(k) + \dot{\gamma} \Delta k \quad (5)$$

$$\dot{\gamma}(k + \Delta k) = \dot{\gamma} \quad (6)$$

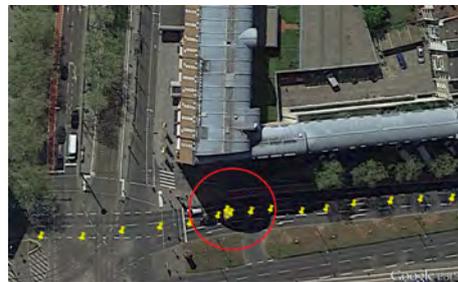
This is an important step, as produced coordinates from the EKF will be used to fetch information from the SQLite database after the required coordinates transformation to issue the warning accordingly.

Conclusion

As shown in figure 1, image "a" on the left-hand side, shows the traveled route as acquired from the GNSS sensor. While in image "b", on the right-hand side, in shows the same route but when it is acquired from the coordinates produced from the EKF. Apparently, the measurements acquired from the EKF are more accurate and much less noisy than those acquired from the GNSS sensor.



(a) Without EKF



(b) With EKF

Figure 1: Comparison between the vehicle position derived from the GNSS sensor and the vehicle position derived from EKF filter

Hochschule Karlsruhe – Technik und Wirtschaft.
 Fakultät IMM • Studiengang Geomatics.
 Bearbeiter: Amr Bakri.
 E-Mail-Adresse: amrmb09@yahoo.com.
 1st Referee: Prof. Dr. Ing. Reiner Jäger.
 2nd Referee: MSc: Silvana Mehmetaj.
 supervisor: MSc. Tianyi Guan.