Enhanced Pedelec Odometry supported by Acceleration Measurement

(Master Thesis)

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Motivation

Rising interest in self driving vehicles necessitates transportation system to become more dependent on high precision of the positioning technology. Bike computers are mostly common nowadays for purposes like navigation, distance and they also measure the speed of the bicycle using a simple sensor which gives a high error rate and delayed updates due to the drawbacks of the single sensor being used. By implementing a data fusion algorithm by combining measurements from various sensors even in the presence of noise we can get the best estimate of the speed of the vehicle. The goal of odometry optimization is to have accurate and reliable velocity data for Surface Pattern Recognition as supporting points for GPS in the future.

State of the art

Different Data Fusion algorithms have been used with multiple speed sensors based on suitable platforms depending on the required performance as to have higher precision with the actual vehicle speed. Among several algorithms no concept seems to be the dominant in every requirement but usage of these Data Fusion methods are mainly applied to the positioning systems as further supporting developments. Thus, the credibility of the positioning data necessitates reliable speed estimations.

Objective

The objective of this thesis is the design of an enhanced Pedelec odometry and for the next step this odometry is used with the IMU for better velocity measurement estimation. The Hall Effect Sensor will be used to get odometry data. The motivation for high precision in odometry assisted by acceleration data from IMU is to perform data fusion with an appropriate algorithm for high frequency velocity data. This increments precision and accuracy for further navigation purposes as well as positioning systems.

Approach

Initially it is important to analyze and determine the concept to get the speed of the Pedelec with minimal error and high-frequency updates. A custom MCU board is then designed with a Unipolar Hall Effect Sensor and Pedelec CAN communication for this purpose. The concept is evaluated with two sensor datas: one from the IMU and the other from the Hall Effect Sensor. The results will be then used in a suitable algorithm for data fusion purpose to get higher precision. The acceleration data is integrated in order to get the velocity which will then be fed to the fusion algorithm along with the odometry data for a better velocity estimation. The results will be compared to the existing process of implementing the existing Pedelec speedometer data along with actual values with measurements to analze the advancement in the velocity measurements.

Betreuer: Martin Schweigler
16.10.2017

Informatik 11
Embedded Software
RWTH AACHEN UNIVERSITY