Lane-level Map Matching Algorithm for Model-scale Vehicles

(Bachelor Thesis)

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Motivation

This thesis is part of the project "SFB/TRR 339: Digital Twin of the Road System and Collaborative Sensor Data Fusion" which is led by TU Dresden and RWTH Aachen. It is under the subproject "Generating Highly Accurate Positioning Data Using Cooperative Sensor Data Fusion". When generating highly accurate positioning data, a useful source of data is the most probable lane position of a vehicle, as vehicles tend not to leave their lanes. A cooperative sensor data fusion aims to gain additional information from the data and can explicitly acquire a vehicle lane position. In smart systems, it is required to determine the trajectory of moving vehicles and match the trajectory on a map. A challenging part of the map-matching problem is to do it on the lane-level using GNSS and vehicle-sensor data. The approach will be tested in the CPM Lab.

State of the Art

Road-level map matching have been achieved using different core algorithms such as probabilistic models as Hidden Markov Model, Conditional Random Field and Weighted Graph Technique. Other algorithms include Particle Filter and Multiple Hypothesis Technique. Road-level map matching with high accuracy using GNSS data was achieved by Newson and Krumm [(1)], 2009, using Hidden Markov Model as the map-matching core algorithm. The algorithm codes were implemented in the Informatik 11 Embedded Software Chair by Stefan Rakel, M.Sc. RWTH. The Hidden Markov Model graph is made of *hidden states, observations, emission probabilities* and *transition probabilities*. The probability of the paths is calculated using the *Viterbi* algorithm.

Objective

The objective of the thesis is to achieve lane-level map matching using Hidden Markov Model algorithm. The main input data to the algorithm is GNSS data describing the position of a vehicle where the data is acquired from sensors on the road. The output of the algorithm is the vehicle trajectory on a given map. Given enough vehicle sensor data, the algorithm will be tested against lane changes and complex position situations. The algorithm is to be tested in the CPM Lab.

Planned Procedure

The planned approach is to implement the Hidden Markov Model algorithm by determining how to calculate the emission and transition probability. The next step is to determine the most probable path and visualise this path on the CPM Lab map. Furthermore, with enough vehicle state data, the algorithm will be tested to detect lane-level positions and changes.

(1): Paul Newson and John Krumm. 2009. Hidden Markov map matching through noise and sparseness

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