There is an increasing demand for GPS-independent surveillance of transport systems such as aircraft, trains, and cars. As earth is surrounded by a magnetic field, this seems an attractive basis for vehicle localization. Especially in the context of railway systems, metallic structures are ubiquitous and generate distinctive magnetic signatures, so that an obvious application is the magnetic localization of trains as an independent channel to GPS. In this thesis, SLAM concepts are applied for accurate train localization based on perturbations in Geomagnetic field. By using high-quality magnetic sensors, an accurate map of track is precreated. For real-time localization, the magnetic field of a track is measured on the spot by an existing array of train-mounted sensors. The position of moving train is estimated using cross-correlation (CC) techniques. However, CC is a highly nonlinear function and thus standard Kalman Filter (KF) is not suitable for accurate position estimation. Therefore alternative to KFs such as Unscented KF, Particle Filter (PF), and other stochastic nonlinear filters should be evaluated for position estimation.

Thesis Work:
- Develop an understanding of SLAM concepts based on Geomagnetic field
- Generate high-quality magnetic map for subsequent localization
- Apply different stochastic nonlinear filters for accurate position estimation of a moving train

The thesis work will be done in co-operation with Deutsches Zentrum für Luft- und Raumfahrt (DLR).

Requirements:
Students with a background in computer science, electrical engineering, mechanical or other engineering majors. Pre-knowledge in Kalman filter, as well as MATLAB programming is preferred. Strong self-motivation, reliability, and critical mind are expected.

Emphasis:
- Theoretical Study
- Software Implementation
- Hardware Implementation

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