Chair of Computational Modeling and Simulation
TUM School of Engineering and Design
Technical University of Munich

Modeling:
Mathematics:
Programming:
Science:

Software Lab:

TrainTracking – Estimating the position and velocity of a model train

Description

This project explores the technical challenges of accurately determining a model train's position and velocity within a defined track system. By integrating multiple sensing technologies and computational methods, we aim to develop a robust localization and tracking methodology.

The core challenge involves selecting and integrating sensor types, such as ultrasound and camera-based systems, to create a comprehensive understanding of the train's movement. The sensor evaluation and placement process is critical, as it must consider factors like resolution, sampling rate, range, and robustness to environmental conditions to provide the necessary data quality and coverage.

The sensor installation will require custom mounting solutions to ensure secure and precise positioning relative to the track layout. Integrating the sensors with the computational platform for data processing and position estimation will also be a key consideration.Our approach requires sophisticated signal processing and state estimation techniques to overcome sensor limitations and environmental uncertainties. Advanced algorithms like Kalman and particle filtering will reconcile multi-sensor data to generate probabilistic position estimates. This involves complex mathematical modeling of motion, noise, drift, and environmental variations.

From a software engineering perspective, the project demands a modular, high-performance approach to real-time data processing. The system must integrate sensor interfaces, implement filtering algorithms, and provide low-latency position tracking, likely using languages like Python or C++ with robotics frameworks. A 3D track layout serves as a critical reference model, providing spatial context for precise position estimation by establishing boundaries and reference points.

Task

GENERAL INSTRUCTIONS:

- Install and calibrate data acquisition systems (e.g. ultrasound sensors and camera)
- Create dynamic motion prediction models and state estimation algorithms
- Design real-time data processing pipeline
- Integrate all subsystems in a modular software framework

Supervisor

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