Mini Project: Implementing State Estimation Filters

Objective

The objective of this assignment is to implement a state estimation filter for a specific application. Students will gain practical experience in understanding and implementing state estimation techniques such as the Kalman filter, Extended Kalman filter, or Particle filter. Additionally, students will explore the applicability of these filters in various domains such as target tracking, SLAM (Simultaneous Localization and Mapping), control, attitude estimation, and signal processing.

Requirements

1. Choose one of the following state estimation filters: Kalman filter, Extended Kalman filter or Particle filter.
2. Example applications: Target tracking, SLAM (Simultaneous Localization and Mapping), Control, Attitude estimation, Signal processing etc.
3. Implement the chosen state estimation filter using a preferred platform (e.g. MATLAB) for the selected application.
4. Document the implementation process, including mathematical derivations (if applicable), code explanation, and analysis of results.
5. Demonstrate the effectiveness of the implemented filter through simulations or real-world data (if available).
6. Submit a report detailing the implementation, including code snippets, simulation results, and analysis.

Instructions

1. Each student must choose a unique combination of state estimation filter and application.
2. You can leverage built-in functions or libraries if necessary.
3. The report should be structured logically, with clear sections for the introduction, methodology, implementation, results, discussion, and conclusion.
4. Provide visualizations (plots, graphs) to illustrate the performance of the implemented filter.
5. Submit the assignment on or before the specified deadline.
6. If you use any AI assistance, include the exact prompts you used and identify the tools by name. Reports with similar or copied content will be penalized.

Evaluation Criteria

1. Correctness of the implementation.
2. Clarity and coherence of the report.
3. Depth of understanding demonstrated in the analysis and discussion.
4. Effectiveness of the chosen filter for the selected application.
5. Creativity and innovation in addressing challenges or limitations.

Note to Students

1. Ensure that you understand the underlying theory behind the selected state estimation filter and its application.
2. Experiment with different parameters and scenarios to fully explore the capabilities and limitations of the implemented filter.