Karlsruher Institut für Technologie

Fakultät für Informatik
Institut für Anthropomatik und Robotik (IAR)
Lehrstuhl für Intelligente Sensor-Aktor-Systeme (ISAS)
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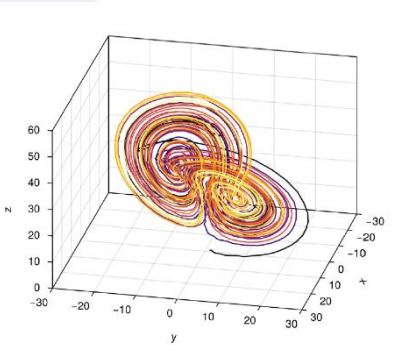
https://isas.iar.kit.edu

Intelligente ISAS Sensor-Aktor-Systeme

Bachelor/Master Thesis

Bayesian Filtering for Nonlinear Systems

Nonlinear filtering focuses on estimating unknown states from noisy observations, where the relationship between the observed data and the underlying state is not linear. While traditional (linear) filtering techniques such as the Kalman filter assume linearity in both the system dynamics and measurement models, nonlinear filtering deals with systems where these relationships are inherently more complex.



Many real-world systems ranging from navigation and robotics to finance and biological processes are governed by nonlinear dynamics. For example, the motion of a robot in a cluttered environment or the tracking of a moving object in the presence of random noise may not follow simple linear equations. Consequently, nonlinear filtering methods become essential for providing accurate state estimates in these types of systems.

At ISAS, we have developed a Julia-Framework called “Filters.jl” to be able to easily implement, evaluate and compare nonlinear filtering methods. The goal of this thesis is to extend this framework by adding additional filters and comparing them to the state-of-the-art. It will roughly consist of these tasks:

- Literature research on nonlinear filtering methods and getting to know Filters.jl
- Selection (and improvement) of promising approaches
- Implementation of selected methods and integration in Filters.jl
- Comparison with other state-of-the-art-methods

Requirements:
This topic is suited for students with a background in computer science, mathematics, electrical engineering, or other engineering majors. High motivation, reliability, and a methodical and independent approach to work are expected. Prior knowledge in stochastics, nonlinear filtering, and the Julia language are advantageous.

Emphasis:

Theoretical Study	
Software Implementation	
Hardware Implementation	

We offer:
- Excellent support and advice
- High-end infrastructure
- Contacts to industry and research partners

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