Control Benchmarking of Ship Models

Background

Autonomous ships are enjoying increasing attention, as innovations in this field will make the oceans safer for both crew and environment, while simultaneously reducing pollution. In contrast to autonomous driving, ship dynamics are often more complex, and thus finding a suitable controller often proves difficult. Still, the task at hand is quite similar: Both ship and vehicle have to reach a goal area, while also avoiding collisions with others.

Typical reach-avoid problem

That said, there is currently little research on applying and extending existing control approaches for autonomous vehicles to ships. In addition, existing approaches often do not produce formally verified results, which is crucial when a controller is applied in the real world and has to regard safety specifications.

Description

This thesis will address this research gap. To that end, we will research and integrate different ship models into the Automated Reachset Optimal Control (AROC) toolbox. For each of these newly integrated ship models, we will evaluate the performance of AROC’s various, formally verified control approaches on a simple reach-avoid problem, and compare them to unverified existing control approaches. Based on these simple, so-called motion primitives, we will then perform online motion planning, where we now consider static and dynamic obstacles.

Tasks

- Perform a literature review on ship models and related, specialized control approaches
- Familiarize yourself with the AROC toolbox and relevant control algorithms
- Compare the performance of the formally verified control approaches in AROC against unverified, specialized control approaches for each ship model
- Evaluate and discuss the benchmarking results
- Optional: Perform online motion planning using motion primitives

References

