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M A S T E R T H E S I S
for
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Trajectory-based Controller-Geometry-Codesign of Underwater Robots

Problem description:

Typical design procedures for underwater vehicles involve standard models for submarine dynamics and an expert adapting these to the specific mission requirements. Often this is an iterative process, as many of the parameters are tightly coupled and immediately influence the dynamics and performance of the vehicle. Furthermore, due to the nonlinear, coupled nature of the vehicle dynamics, changes in the vehicle design parameters strongly affect the control design, requiring often a controller redesign. In this work, we adopt a system-engineering approach to the controller-geometry-codesign: specification of a set of design requirements is directly derived from a set of trajectories the vehicle should perform. A suitable trajectory representation should be chosen and key requirements identified. In the design phase, an automated co-design of the optimal kinematics and dynamics of the robot together with the synthesis of a stable controller for tracking the trajectory is aimed for. The resulting vehicle model with controller should be evaluated and tracking of the required trajectories should be verified.

Tasks:

- Literature research
- Dynamic model for underwater robots based on parametrizable model architecture
- Kinematics and dynamics optimization based on trajectory-requirements
- Control design based on trajectory-requirements
- Simulation and evaluation

Bibliography:

[1] A.N. Vollmayr, S. Sosnowski, S. Hirche, and J.L. van Hemmen, "Snookie: an autonomous underwater vehicle with artificial lateral line system.", In *Flow Sensing in Air and Water*, chapter 20, pages 521562. Springer

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