Bachelor’s Thesis

« Centralized Calibration of an Underwater Localization System »

Motivation
Underwater localization and navigation is an important prerequisite for autonomous driving of underwater vehicles. Typical over-water systems, e.g., global navigation satellite systems (GNSS), do not work underwater due to the high damping of the electro-magnetic wave in the water and the reflection of the wave at the water surface.

In this context, the ahoi modem, an inexpensive and low-power acoustic underwater modem, has been developed at our institute. The ahoi modem enables an underwater communication and distance measurements. Based on a system of anchors with already known positions and distance measurements, underwater vehicles can localize themselves.

Work Description
During this project, you will develop a centralized anchor calibration system. Each anchor consists of a surface unit (Raspberry Pi, GNSS device and battery) and a submerged ahoi modem. Based on the identified GNSS positions and underwater distance measurements, your system will give a precise estimate of the anchor positions. You will start with a research study about acoustic distance measurements and localization. Afterwards, you will upgrade the surface stations with GNSS devices. Based on your findings and preparations, you will implement a software for a centralized calibration. At least, you will evaluate your system in a real-world scenario.

In particular, the thesis will comprise the following steps:
1. Research study about acoustic distance measurements and localization
2. Implementation of a calibration system
3. Evaluation in the real-world

Prerequisites
For successful thesis completion, you should fulfill the following requirements:
- Background in digital communication or signal processing
- Knowledge of geometric algebra and overdetermined systems
- Practical experience with the C and Python programming languages

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