Section Sciences et Ingénierie de l'environnement
Design Project 2017 (semestre de printemps)

Proposition n°20

A Coupled Simulation Tool for Autonomous Underwater Vehicles engaged in Environmental Monitoring Missions

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Descriptif du projet
Hydromea SA was founded in 2014 and developed a small (length: 70cm), autonomous underwater vehicle (AUV), essentially an underwater robot. The robot is fitted with a number of sensors which allow it to determine many physical-chemical water parameters such as temperature, conductivity, pH, O_2, chlorophyll, blue-green algae and turbidity as it traverses the water. The AUV can either follow a list of pre-programmed coordinates or adaptively control its course based on what it measures as it goes along. The AUV is specifically designed to operate in large swarms where the members of the swarm exchange data about what they measure in real-time and are capable of determining their relative position to each other. These abilities should allow the swarm to cooperatively determine an existing gradient of a parameter and collectively follow it ("adaptive sampling"). A comprehensive and faithful simulator for the vehicle has also been developed.

Objectif
In order to effectively assess the capability of a swarm of AUVs to collectively map a water volume and test algorithms which would adaptively follow a gradient, Hydromea is seeking to integrate existing simulation engines for environmental fields with the vehicle simulator. The idea is that a state-of-the-art model of a targeted environmental field generates snapshot within which the vehicle simulator can run several instances of an AUV.

A first step within this project would be a survey to get an idea of the existing simulation techniques and engines available for water bodies and analyze them with respect to their capabilities, computational costs and applicability for different environmental parameters.

The second step of the project would be the coupling of a suitable field simulator with the vehicle simulator and evaluating the performance of the overall coupled simulation engine by, for instance, implementing a simple adaptive sampling algorithm within this framework (e.g., following a temperature gradient).

Descriptif tâches

- survey of existing modeling techniques and simulation engines for aquatic environmental fields
- comparison of engines with respect to computational costs, applicability to various environmental parameters
- integration of engine output with AUV simulator
- analysis of possible differences between simulated output and real-world measurements
- implementation of a simple gradient following strategy within the framework

Divers

For this project we are looking for somebody with a strong interest in modeling of environmental fields, particularly in a 3D aquatic environment. This project also requires a good command of the C and Matlab programming languages. Experience in integration multiple software frameworks through APIs and knowledge of the Python language (as a possible alternative to C coding) is a bonus.

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