Design of Control System for Underwater Gliders

SURGE-2023 Research Proposal

-Under guidance of Prof. Soumya Ranjan Sahoo, EE

Introduction: -

Underwater gliders are a special class of Autonomous Underwater Vehicles used for sea exploration missions which do not use thrusters to move underwater. It is a very low power consuming fully electric AUV having prolonged deployment times ranging in many days before needing charging.

Research Problem: -

1. **Underwater Glider Description: -** Instead of actively consuming power and achieving 6 Degrees of Freedom with the help of thrusters, Underwater Gliders take in water into their so-called Buoyancy Engine located on the front part of the hull to shift their Centre of Mass ahead of their Centre of Buoyancy. This causes the glider to sink as well as tilt and when the Pitch and Heave movement is coupled with the Dynamic effects generated by the Wings it gives rise to Surge motion. Apart from that shifting the battery modules and other objects inside the hull can give rise to Roll, Yaw, and Sway as well.

2. **Non holonomic nature of the Problem: -** Usually an AUV has no problem with achieving all 6 degrees of freedom independent of each other by adjusting the speed of the thrusters. However, the Underwater Glider generates thrust using the static and dynamic effects of Water and Water-Glider interaction- Buoyancy and Drag. The Glider can achieve Surge only by executing Pitch and Heave. The instruction to the glider is a simple straight line but the motion it executes is along a curve. This leads to the problem no longer being a holonomic controlled system but a non-holonomic one. Certain maneuvers are not possible due to impossibility of sharp curves and the glider needs to reposition itself to reach certain points.

3. **Designing a control system for the Underwater glider: -** The heart of the mission planning of an Underwater Glider will need to use a Control system working on the dynamic model of the Glider and water. The control system will take in the desired point to reach as an input and instruct the motors in the Glider to draw in water or change the position of modules in appropriate amounts to reach the desired points. The control system will have to deal with the non-holonomic nature of the problem. A suitable decision about the type of controller to use needs to be taken after modeling the problem.

4. **Optimizing the control system: -** To ensure efficient travel and minimal use of energy, the controller needs to be tuned and optimized.

Conclusion: - Modeling and simulation of the dynamics of the Underwater Glider followed by the control system design and optimisation is the area that the project will mainly focus on and hopefully an optimized and working controller of Underwater Glider can be achieved by the end of the project.