Vertical Control of Biologically-Inspired Underwater Robot

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Introduction

Underwater vertical robotic manipulation is used for multidimensional maneuverability for underwater vehicles to clear plant life from a canal. Ballasts displace water between the surrounding water and a containment chamber inside the robot to allowing vertical maneuverability [2].

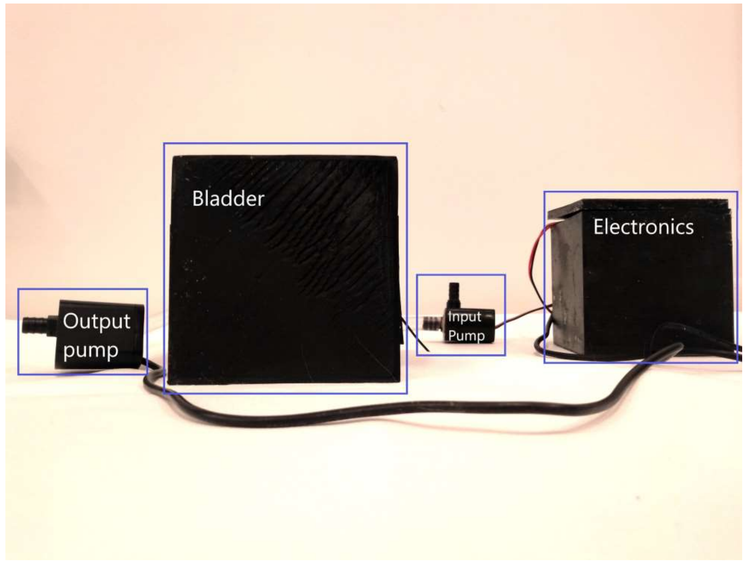

Figure 1: Ballast prototype

Model

- Buoyancy depends on the relative mass of the object, m_s, density of the water, ρ_w, and the volume of water that is displaced, V_{shell} (2).
- Neutral Buoyancy is achieved when relative weight is equal to the buoyant force (1).
- Position control of the object by changing the volume of water in the system (4).

(1) $F_G = F_B$ (3) $m_s + \rho_w V_w = \rho_w V_{shell}$

(2) $mg = \rho g V(t)$ (4) $x = \iint \frac{m_s + \rho_w V_w - \rho_w V_{shell}}{m_{sys}} dx$

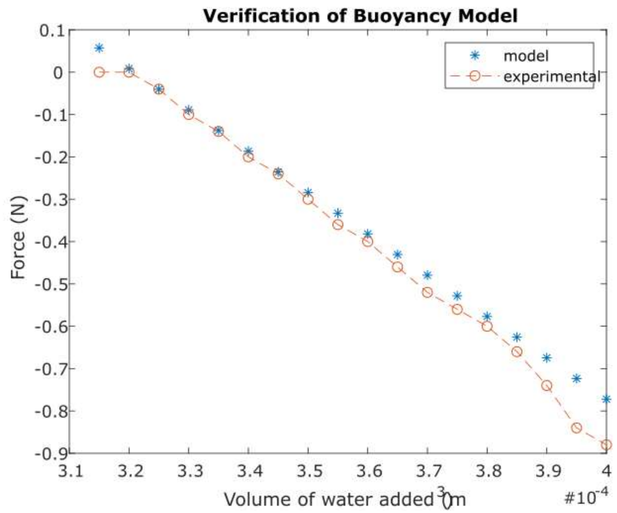

Figure 2: Matches model data to experimental data

Future Work

- Ballast pressure is measured to compute buoyant force.
- External pressure is used to measure depth.
- PID control is used to control the system's vertical position based on the external pressure sensor.

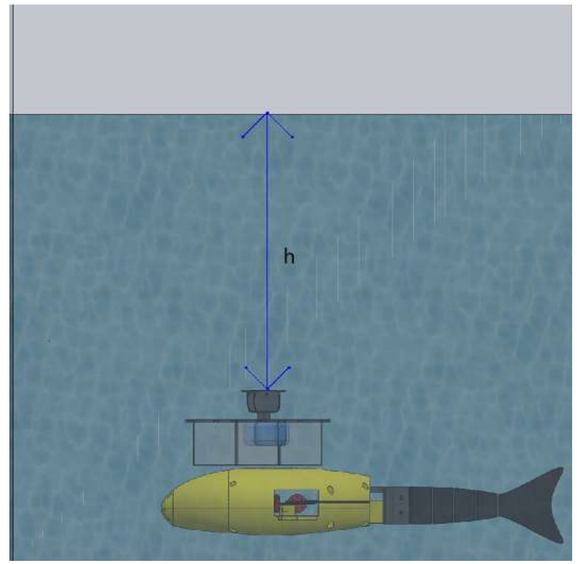

Figure 3: Measuring lateral position and pressure

References

[1] Børseth, S. (2018). *Low Energy Buoyancy Actuator for Vertical Underwater Motion*. [online] Brage.bibsys.no. Available at: https://brage.bibsys.no/xmlui/handle/11250/2461343 [Accessed 26 Oct. 2018].

[2] Woods, S., Bauer, R. and Seto, M. (2012). Automated Ballast Tank Control System for Autonomous Underwater Vehicles. *IEEE Journal of Oceanic Engineering*, 37(4), pp.727-739.

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