Introduction

- Underwater lateral robotic manipulation is used for multidimensional maneuverability for underwater vehicles [1].
- Ballasts displace water between the surrounding water and a containment chamber inside the robot to allowing vertical maneuverability [2].
- The goal for this underwater robot is to clear plant life from a canal.

Model

- Submerged object’s buoyancy depends on the relative mass of the object, \( m_s \), density of the water, \( \rho_w \), and the volume of water that is displaced, \( V_{\text{shell}} \) (2). \( F_G \) is the force of gravity of the object and \( F_B \) is the buoyancy force.
- When relative weight (RW) of the object is equal to the buoyant force (1), the object is neutrally buoyant.
- Position control of the object by changing the volume of water in the system (4), which describes the sum of forces.
- Equation (6) describes the relationship between pressure and volume.

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\begin{align*}
(1) & \quad F_G = F_B \\
(2) & \quad mg = \rho g V(t) \\
(3) & \quad \text{RW} + \rho_w V_w = \rho_w V_{\text{shell}} \\
(4) & \quad ma = \text{RW} + \rho_w V_w - \rho_w V_{\text{shell}} \\
(5) & \quad h = \int \frac{m_s + \rho_w V_w - \rho_w V_{\text{shell}}}{m_{\text{sys}}} \, dh \\
(6) & \quad V_{\text{shell}} = nRT
\end{align*}
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Design Process

- The first prototype has a fixed volume with variable amount of water input using a one-way pump (Figure 1).
- Flexible air bladders are contained in 3D-printed rigid boxes. Water is pumped into the flexible air bladder to compress the air in the rigid structure.

Data Collection

- Height will be measured with visual recognition software and is plotted against time.
- Pressure has an effect of the performance of underwater robotic components.

References