

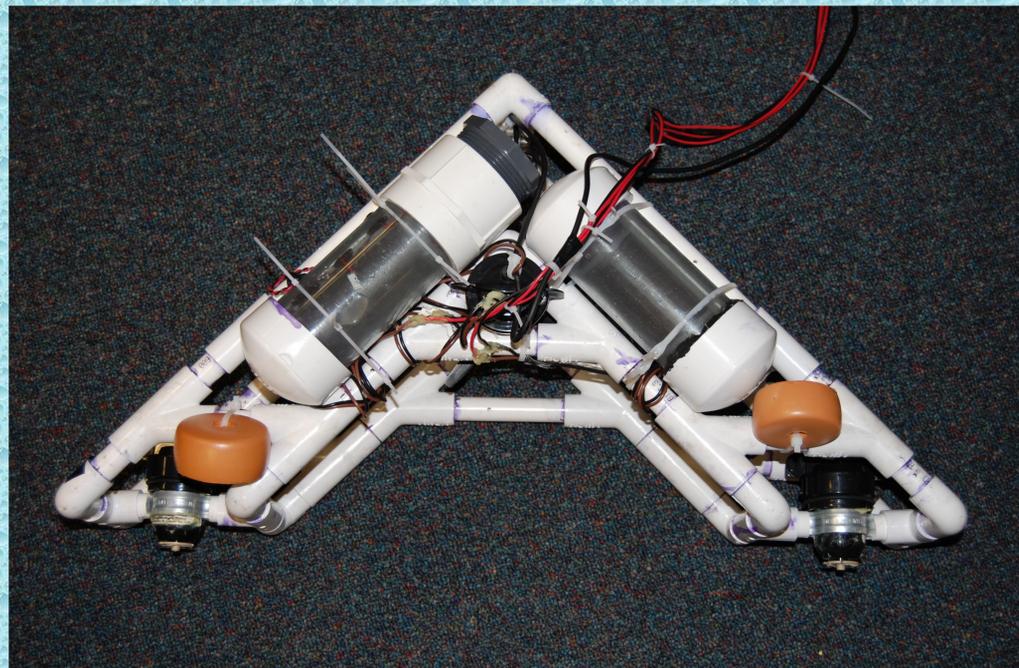
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2.00AJ / 16.00AJ Exploring Sea, Space, & Earth: Fundamentals of Engineering Design
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The Sea-Saw

The Sea-Saw is an ROV designed to collect environmental data near shore/a boat. With a “boomerang” shaped body, the Sea-Saw is balanced, streamlined, and easy to turn.



Design

The Sea-Saw moves using three motors; two direct forward motion and turning, while a third was originally designed to operate a rudder controlling vertical movement. This was ultimately changed to a vertical thruster due to manufacturing complications.

The two lateral motors are placed at the end of each side-section, with the largest possible distance between them given size constraints. When both motors are firing at the same power level, the Sea-Saw will be propelled forward or backward as a result of the two combined forces. By firing only one of the motors, the craft experiences a moment and will therefore turn about its center of mass.

In the original design, as the ROV would move forward, it would be able to change altitude by pivoting a rudder located at the center of the frame. As this rudder pivots, a lifting force is applied to the rudder, propelling the robot upwards or downwards depending on the direction of the rudder relative to water flow.

This rudder is fixed to an axle which rotates under the power of a third 50gal/min motor, which is coupled to the fin by a worm on the motor shaft and a worm gear on the fin axle. (See Figure A)

2.00A Final Project

Data Collection

The Sea-Saw is designed to collect pressure, temperature, light, and conductivity through a custom sensor package.

Though we were able to obtain numbers from our sensor package, the data itself is uninterruptible due to a number of issues. Among these were: we were unable to upload the most current data-interpretation program to the package, we discovered that a wire on the temperature probe was sheared off, and the data that was collected was difficult to calibrate because there was no time attached to the data and the pressure sensor was never functional.

Performance Analysis

Design Strengths

The turning capabilities of the craft were excellent: the ROV rotated quickly, even while deep under water, without listing to one side.

Motor placement was a second design strength: the placement of the vertical motor at the center of mass allowed for a controlled ascent and descent that could be carried out at the same time as the craft was moving forward or even turning. The position of the side motors, aside from contributing to excellent turning, allowed the craft to move both forwards and backwards effectively.

Another strong point of our design was weight and buoyancy distribution. Allowing the frame to fill with water made the frame neutrally buoyant. The balance of weight elements (camera at the front, motors at the back) and buoyancy elements (small buoys at the back, buoyancy chambers near the front) was such that the craft balanced itself in the correct position while in the water- we only made only one adjustment after placing it in the water the first time, adding a small weight to the front.

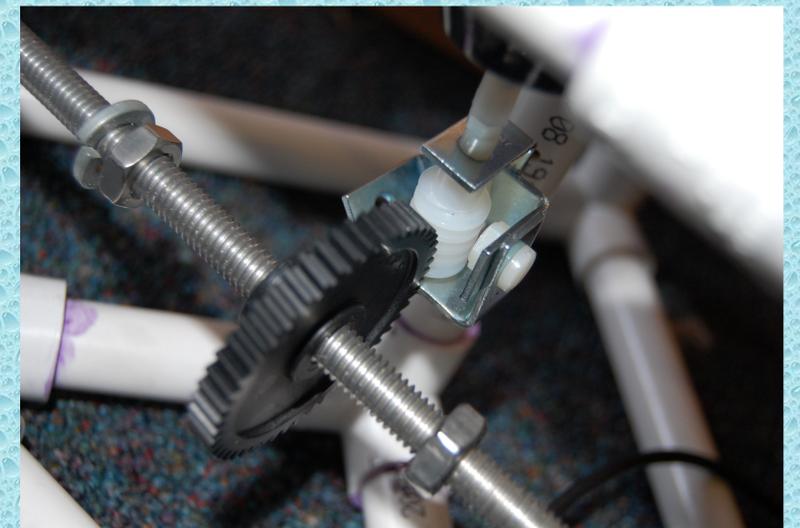


Figure A—Worm Gear

Design Weaknesses

The biggest weakness of our original design was its complexity. We had originally included a rudder that would control the vertical motion of the craft, and though we completed most of the steps necessary for this addition, we lacked access to some of specialized equipment necessary to complete the process. Going forward, it would be wiser to choose a simpler design given similar time constraints.

We chose to make all three of our motors 500 gallon/hour motors and, in hindsight, we should have chosen 750 gallon/hour or even 1000 gallon/hour motors. This swap would have made the craft move more quickly and, as we had higher-power options available, would have been a trivial change to make. While testing, we did try to increase power by increasing the voltage from 12 volts to 24 volts (i.e. by attaching the circuit to two batteries instead of one.) This resulted in the motors spinning so quickly that one of our propellers was flung across the dock.

We also had an issue with our control box: when we constructed it, we followed the Seaperch manual. However, the Seaperch used smaller motors than did our craft, and directed us to use wires of insufficient gauge. This resulted in the control box getting completely fried; the wires melted together, creating a short and a lot of smoke.

Finally, it would have been much more convenient if the buoyancy chamber containing the sensor package had had threaded caps on both sides. As it was, the USB port and the serial port pointed in opposite directions, making it difficult to access both once the package was in place.