Autonomous Underwater Vehicle

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Printed Circuit Board

Palouse RoboSub Club

Palouse RoboSub Club consists of multiple Engineering disciplines which share the common Goal for developing a fully Autonomous Underwater Vehicle (AUV) to compete in the yearly international AUVSI competition in San Diego, CA. RoboSub Club is also a diverse student organization focused on collaborative engineering and design; having senior design teams from both Washington State University and University of Idaho.

Data Acquisition System

Hydrophones

Analog to Digital Converter

GPIO

Voltage conditioning

Printed Circuit Board

Cross Correlation

Hydrophones h1, h2, h3, h4 detect a signal from the static underwater pinger and compare the time delays between them to find the location of the pinger relative to h1. h1 is at location (0,0,0) (the origin) h2 is at location (δ ,0,0) h3 is at location (0, ε ,0) h4 is at location (0,0,ζ ) When a signal is detected by the hydrophones, they create time stamps relative to the reference hydrophone.

\[ \Delta t_2 = t_2 - t_1 \]
\[ \Delta t_3 = t_3 - t_1 \]
\[ \Delta t_4 = t_4 - t_1 \]

These three time differences are multiplied by the speed of sound to get the difference in distance from the pinger.

To get the time delay between two hydrophones, we take the signal received by each hydrophone and convolve them together to get a cross correlation vector. This cross correlation vector is used to calculate Δt as shown below.

Impact Analysis

The last few years have been very crucial and important for the autonomous robotics industry. Projects like RoboSub proves how even college students are feasible to learn and create a robot that can perform task and complete obstacles without human input. Team Xebec’s subsystem to navigate the autonomous submarine can not only be modified to explore oceans but can also track objects above ground.

Glossary

Hydrophone: an underwater microphone for detecting sound
Zybo: Digilent’s Zynq field programmable gate array (FPGA)
GPIO: General Purpose Input Output is a generic pin on an integrated circuit controllable by the user at run time
Bandpass Filter: A hardware based filter that allows signals between two specific frequencies to pass
ADC: Analog-to-Digital Converter, used to convert a signal operating in analog spectrum to digital.

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Team Xebec