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Sensing the World Through Robotics

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Pacific Nautilus Autonomous Vehicles Land, Sea and Air Vehicle Team

Introduction

Pacific Nautilus is a Not-For-Profit Student organization dedicated to increasing the number of high school, community college, and minority students to participate in cutting edge and hands-on engineering projects with an interest in autonomous vehicles. In its 5th year as an organization Pacific Nautilus will make its 4th entry in the Association of Unmanned Vehicle Systems International (AUVSI) Foundation & Office of Naval Research's (ONR) 13th International Autonomous Underwater Vehicle Competition.

AUVSI

ONR Office of Naval Research

This year's entry has progressed from last year by utilizing the existing custom design that implements a double hull structure to insure that our circuit boards are protected. We have added a smaller pressure, tilt and gyroscope sensors to our half brain. The inner and outer hull is securely sealed using gaskets and an aluminum outer plate to increase structural integrity. The electrical system has been designed to utilize Lithium Ion batteries for their lightweight high power-density allowing the vehicle to have longer run times between recharges as well as minimal impact on over-all weight. Computational algorithms are carried out via Microchip microcontrollers.

PURPOSE

To better understand our fields by looking at real-world engineering problems.

The goal is to apply our knowledge in the sciences to produce solutions in a professional setting.

To produce a fully functional AUV (autonomous unmanned vehicle) to compete in this year's AUVSI and ONR competition.

Methods

Temperature Compensated Gyroscope

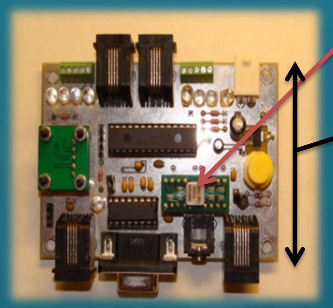
·Prior to testing, a list of all materials and procedures must be documented, for future volunteers to understand the process which was taken.

Dana writing up documentation

·The EVAL-ADXRS610Z, which is a yaw rate gyroscope with a bandwidth of 20Hz.

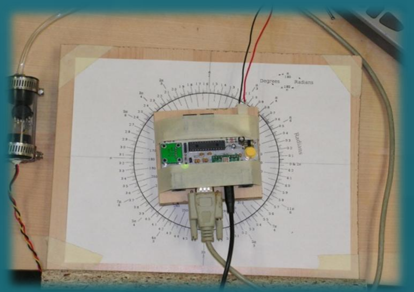
·The gyro outputs analog data corresponding to the yaw from the orientation of the circuit board that it is connected to, in our case the half-brain (Microchip PIC18F2525).

·The half-brain was mounted on top of a 3"x3" wooden board then placed on top of a radian chart. 5V was applied across the half-brain using the 12V power supply and linking it to a laptop to gather data.



Gyroscope (EVAL-ADXRS610Z

Half-brain (Microchip PIC 18F2525)



Half-brain mounted on 3"x3" flat board with radian chart

·Created simulation by manually rotating the half-brain in various degrees of rotation, analog data was obtained. We then converted the data into a 10 bit digital number between 0 and 1023 then graphed.

·This data is then converted into angles so the programmer can set functions based on angles rather then random numbers .

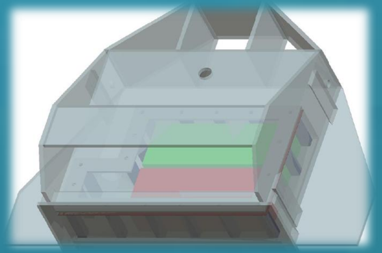
Securing the Hull/Inner Circuit Box For Leaks

·All gaskets and seals were placed in designated areas, and screwed shut as if it were in actual competition. Then placed in a 5 gallon bucket of water with weights to keep it submerged. From careful observation bubbles were spotted indicating that there were leaks.

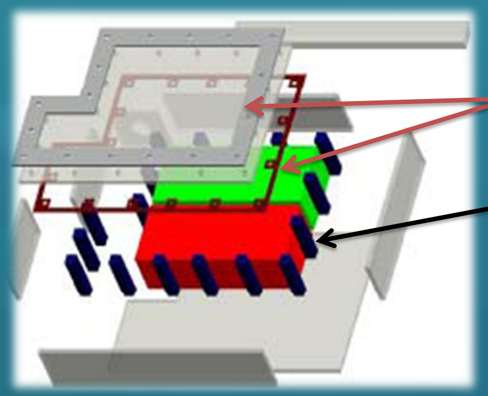
·After locating all possible areas that contained miscellaneous cracks and holes. The hull/inner circuit box was unscrewed and unsealed.

·Loose threading for screws were re-glued back on to the hull, minor cracks and holes were filled in with adhesive silicone, and seals were re-lubricated.

Bryan checking the Delta A for leaks.



Pro Engineering Wildfire 4.0 rendering of Delta A.



Rubber gaskets

Threading for screws

Inner circuit box

Hydrophones

Lab-Core Systems Custom Hydrophones

·Hydrophones are underwater microphones.

·We plan to use three in the shape of an equilateral triangle, so we can determine the direction of incoming sounds.

·With all three hydrophones picking up the same signal at different time stamps, we will be able to determine which direction the sound is coming from.

·Rotating the vehicle allows the 2 base hydrophones to pick up the same signal at the same time.

Pressure Sensor

·Due to our budget we had to design and create our own pressure sensor.

·The challenge was to create a mechanism that could produce a close-to linear correspondence between the vehicle's depth and the output of the GPS.

·In the end, a diaphragm design was used because it was able to be much smaller with consistent results, unlike the other prototypes.

Left , Christopher Carter; Middle, Dr. Colin Bradbury; Right, Frank Yepiz.

Dr. Bradbury giving Frank an option for pressure sensor.

·The gas pressure sensor is an MPX5700GP from Mouser Electronics. This sensor is actually a gauge sensor that was adapted to function as an absolute sensor by covering its reference pressure port.

·The sensor is connected across 5V from the half-brain by way of a single cable that also carries the analog signal back to the half-brain for processing.

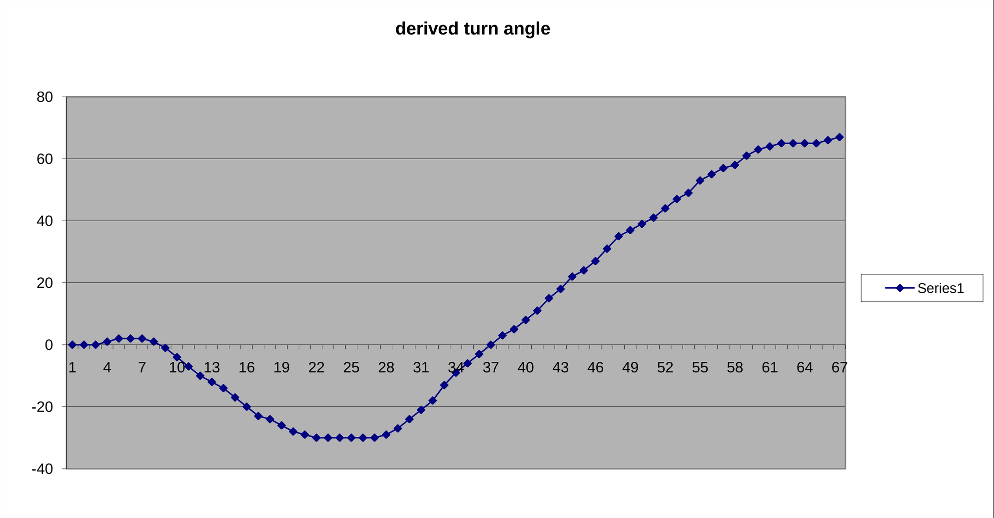
Franks' pressure sensor (Frankenstein pressure sensor) .

·The half-brain logs voltage data, which correspond to different depths. With this information the programmer is able to tell the robot to exceed or not to exceed certain voltages.

RESULTS

Temperature Compensated Gyroscope

·This is a graph of the data that was converted from a 10 bit digital number into angles versus time.



•With this new information the programmer is able to code a program that allows the robot to stay level and not tilt to the point of no recovery.

Securing the Hull/Inner Circuit Box For Leaks

·Hull and inner circuit box was successfully sealed and secured.

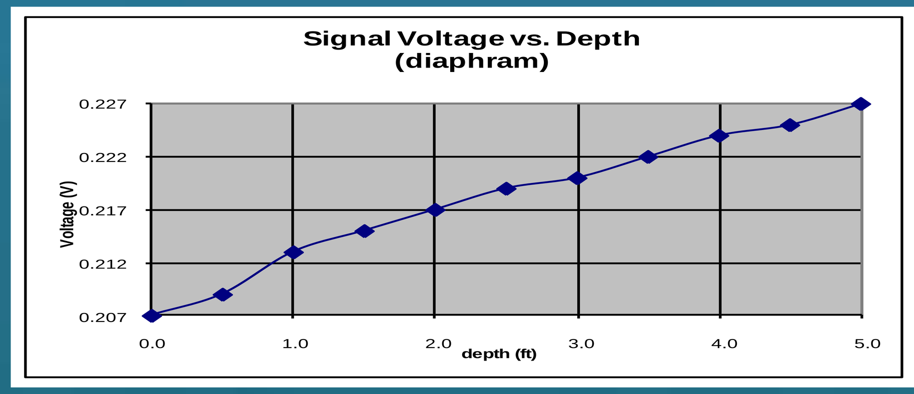
Hydrophones

·When implemented to the AUV it was a success. The programmer was able to come up with a program that was successfully able to direct the vehicle to the frequency we specified.

Pressure Sensor

·After deciding to use the diaphragm pressure sensor we collected data and converted that data into usable information.

·In this graph you can see which voltages correspond to which depths.



Conclusion

·In conclusion we were able to conceptualize the mechanics of autonomous systems. We were also able to work efficiently in a cooperative and individualized type setting.

·From this opportunity we established communication with industry professionals.

·It gave us insight and exposed us to the daily tasks of real world problems in the field we are pursuing or related to.

·We acquired new knowledge but also had the chance to use our own experience and academic knowledge and applied it to produce solutions.

Acknowledgements

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