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ANGLER: Autonomous Network for
Gradient Location in Environmental Research

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ANGLER: Autonomous Network for
Gradient Location in Environmental Research

by

Alvaro Gandara Astray, Gregory Emmanuel, Jake Pfitsch, Michael Vlahos,
Dean Willmert, and Alexander Wroblewski

SENIOR DESIGN PROJECT REPORT

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ANGLER: Autonomous Network for
Gradient Location in Environmental Research

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Abstract

In the field of marine science, there exists a lack of efficiency present in data collection methods, especially for small bodies of water. This has begun to be addressed by the Santa Clara University Robotics Systems Lab (RSL) cluster boat project, of which project ANGLER is a continuation. The goal of this project was to design and fabricate an upgraded, second generation vessel for the cluster boat project. The primary function of the upgrade was to implement sensing capability, along with the necessary improvements to other systems to support this ability. The upgraded vessel was outfitted with a sensor package, a new, robust structure to support the sensors and electronics, improved communications hardware to support the increased bandwidth needs, and a new software implementation to better coordinate the motor control and sensor data. The system requirements included a minimum sensing rate of 1 Hz, a stable, modifiable structure, a sufficiently maneuverable vessel and communication hardware capable of handling the increased data transmission rate. These requirements were all met through a series of bench and field tests that produced a depth map using GPS and depth sensor data gathered at a local reservoir. The prototype boat demonstrated the ability to collect relevant data, leading us to the conclusion that integrating the ANGLER boat into the cluster boats project and implementing sensors on all of the boats would create an effective method of data collection for small bodies of water. Before the vessel is incorporated into the RSL cluster, a few upgrades are recommended. First, the wireless communication devices should be swapped for a longer range, lower bandwidth model. Second, the wiring and waterproofing of the system should continue to be addressed to ensure robustness in rough conditions. When these upgrades are implemented the ANGLER vessel will be ready to incorporate into the RSL cluster boats project.
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Chapter 1: Introduction

1.1 - Background/Motivation:

The Earth’s lakes, rivers, and oceans are some of humanity’s greatest resources, providing a home to countless species of plants and animals and serving as the continuously flowing lifelines of human civilization. Of all of these habitats, the coastal areas are some of the most productive and diverse regions; however, they are also the most adversely impacted by humans. A number of events including industrial run-off, oil spills, algal blooms, over-fishing, and the consequences of climate change can threaten the stability of these ecosystems. Two of these harmful marine events can be seen in Figure 1. Due to their economic, environmental, and social importance, the study, understanding, and monitoring of these regions is absolutely vital.

![Figure 1: A devastating "red tide" algal bloom & the Exxon-Valdez oil spill](http://serc.carleton.edu/images/microbelife/topics/red_tide_for_ed.jpg)

![Figure 1: A devastating "red tide" algal bloom & the Exxon-Valdez oil spill](http://trendsupdates.com/wp-content/uploads/2009/06/Exxon-Valdez-oil-spillage.jpg)

Scientists have been researching aquatic life for decades and have benefited greatly from the evolution of marine technology. Current data gathering methods in marine research exhibit a division for large and small bodies of water. Testing in small bodies of water is usually done manually as seen in Figure 2. Scientists spend hours taking individual samples by hand and bringing them back to their laboratories to perform tests. While adequate for very small bodies of water such as creeks and streams, this method of data collection quickly becomes ineffective, inefficient, and laborious for characterizing lakes, seas, and coastal regions. Manual testing wastes valuable time and

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References:


