

### **Increased Functionality of an Underwater Robotic Manipulator:**

Abstract—Research into underwater robotic applications is currently a growing field. There are many challenges involved in underwater robotics that are not present in other mediums, such as how the harsh environmental conditions that this environment invokes onto the robot and any equipment that is attached to the robot. In this paper an attachment to an underwater gripper is proposed that adds another Degree Of Freedom to the system, thus allowing the gripper to move along the belly of the robot. Adding this functionality to the gripper has many advantages, some of which involve the robot being able to easily pass a collected object to another robot with minimal interference. This attachment is constructed using 3D printed parts, a waterproofed servomotor and a leadscrew to provide linear motion to a commercial gripper.

### **Depth Estimation of an Underwater Object Using a Single Camera:**

Abstract—Underwater robotics is currently a growing field. To be able to autonomously find and collect objects on the land and in the air is a complicated problem, which is only compounded within the underwater setting. Different techniques have been developed over the years to attempt to solve this problem, many of which involve the use of expensive sensors. This paper explores a method to find the depth of an object within the underwater setting, using a single camera source and a known object. Once this known object has been found, information about other unknown objects surrounding this point can be determined, and therefor the objects can be collected.

### **3D Printed Underwater Housing:**

Abstract— 3D printing, or adaptive manufacturing, has become a common tool to use when developing attachments for many different applications. In this paper, the viability of using inexpensive Fused Deposition Modelling 3D printing techniques to develop a housing to hold sensors is explored. The developed housing is not only required to hold the sensors, it also needs to be able to conform within the given predefined mounting points of a commercially acquired robot. The main challenge proposed is the ability for the device to be able to be submerged under the water for extended periods of time while an AUV is completing a variety of tasks.