ID32 AN APPROACH TO THE APPLICATION OF ADDITIVE MANUFACTURING FOR WATER ENVIRONMENTS: A CASE STUDY TO MEASURE DISSOLVED CARBON DIOXIDE

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ABSTRACT

This paper describes the design of a case for the grouping and protection of the elements required for the quantification of dissolved carbon dioxide, allowing measurements to a depth of 10 meters. The possibility of implementing additive manufacturing (AM) technologies to reduce the production cost and design capabilities of the system is studied.

Keywords - Additive manufacturing, Product design, Carbon dioxide, Low-cost, Dissolved

INTRODUCTION

To understand the variability of carbon dioxide concentrations in different terrestrial systems, field measurements are necessary and require high quality equipment which must be used in large quantities and over long periods of time. However, the existing products on the market are excessively expensive.

This situation has led to the proliferation of projects for the adaptation and implementation of Non-dispersive Infrared sensor (NDIR) technology [1,2,3]. NDIR sensors offer good performance at low cost and minimal maintenance and infrastructure requirements [4,5]. By contrast, there are few case studies with the purpose of forming a container/enclosure that protects the different electronic equipment from the aqueous environment, being mainly studied in this field the surface measurement equipment [3,6,7].

This work focuses on the creation of a housing for the grouping of the elements necessary for the quantification of carbon dioxide dissolved in water, allowing measurements to be taken at a depth of 10 meters. The ability to implement additive manufacturing technologies in order to reduce the production cost of devices is also studied.

THE APPLICATION OF ADDITIVE MANUFACTURING

Two additive manufacturing techniques were studied, Fused Deposition Modeling (FDM) and Stereolithography (SLA) for their technical capabilities and market presence. Thus, two prototypes of similar shape and purpose were manufactured with both techniques. PET-G was used for FDM while ELEGOO ABS-like photopolymer resin was used for SLA. The different casings were immersed in water to a depth of 5 meters to observe the particularities of the technique and possible complexities, Figure 1.

Fig 1. A: FDM prototype immersed in water. B: SLA prototype open.

RESULTS

Limitations of the FDM technique due to the presence of defects/holes in parts resulted in low watertightness, although, surface finishes of two coats of polyester resin were applied by brush.

On the other hand, SLA offers better performance together with the use of surface finishes, making it possible to obtain watertight housings. However, the use of photopolymer resin presents problems of embrittlement and deformation when exposed to prolonged periods of time, these facts should be studied in greater depth.

CONCLUSIONS

Through the different prototypes it has been possible to conclude the capabilities and methods for the use of additive manufacturing in the conformation of parts/devices for aqueous environments. Likewise, a functional prototype of a probe for the measurement of dissolved carbon dioxide case to measure dissolved carbon dioxide has been generated, which can be used in future research.

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ID33 LONG BASELINE (LBL) POSITIONING SYSTEM FOR THE CRAWLER TELE-OPERATED UNDERWATER VEHICLE IN OBSEA OBSERVATORY

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Keywords: Tele-operated Underwater Vehicle; Acoustic Communications; Hydrophone Array; Long Baseline (LBL) Positioning

ABSTRACT

Due to the increased interest in maritime exploration, underwater robots, or remotely operated underwater vehicles, are essential to marine research projects like monitoring ocean pollution. [1], marine biology exploration [2], [3], and industry applications [4], [5]. Reliable navigation data is necessary for effective navigation and control of the tele-operated underwater vehicle, and precise placement is required. [6]. A long-baseline system (LBL) is an acoustic positioning technology for underwater vehicles, affording high accuracy and a broad operational spectrum [7], [8]. But in a low signal-to-noise ratio (SNR) and reverberation environment, biological noise, multipath fading channels, and other environmental noise commonly affect an LBL positioning system, reducing the underwater vehicle distance measurement accuracy and ultimately affecting the vehicle positioning accuracy.

Designing a special configuration of an LBL system in the OBSEA cabled observatory[9] environment, we will be able to detect with more precision the objects that are under the water and incorporate them to improve the navigation and, therefore, the mapping of the robots. This work is based on the OBSEA cabled observatory, which is part of the EMSO (European Multidisciplinary Seafloor and water column Observatory), and the underwater Crawler [10], a Remote Observation Vehicle (ROV), which is a modified version of the "Wally" platform series. The Crawler is easily deployable for monitoring to depths up to 50 m. In this work we use an acoustic system of uWave modems [11] with the NeXOS hydrophones [12] for getting a LBL position system. Later, we used this system to determine the position of the Crawler using triangulation around the OBSEA platform.

As it is illustrated in the Figure 1 we position the four hydrophones and a modem on the top of the artificial reef, at 3 meters high from the seafloor, close to the OBSEA, in order to avoid interferences in