Design of Nose-cone for Autonomous Underwater Vehicle

Today's Autonomous Underwater Vehicles (AUV) are often equipped with a wide variety of sensor and communication equipment. This makes them complex to manufacture with traditional technologies, and the need for modularity, customization, volume and weight optimization is huge. Therefore, the emerging technology additive manufacturing was investigated as manufacturing method for an AUV hull design, enabling design freedom, customization and optimization.

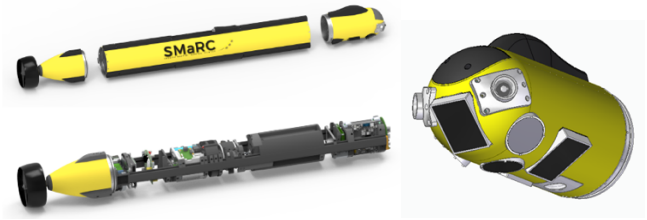
This paper presents a feasibility study of a developed underwater robot nose-cone design using additive manufacturing.

Introduction

The ocean is a challenging environment which make it difficult to design and develop robust AUV's. Not only does the hull design have to withstand the hydrostatic pressure at a certain depth and be waterproof, it also has to provide a housing for electronics and water sealed placements for communication and sensor equipment. The sensor and communication equipment are commonly placed on the nose-cone hull of the AUV where hydrodynamics, volume and weight optimization, and inside electronics are confined in the same space. To approach all the above-mentioned aspects, the nose-cone design needs to be complexly designed and optimized with design freedom, the manufacturing method that could potentially be viable for that is additive manufacturing.

SAM AUV

SAM stands for Small-sized Affordable Maritime robot, it is a platform built mainly for researchers to test and validate their research using the AUV. SAM is developed for three use cases, which are ocean production, safeguarding society and environmental sensing. Ocean production is focused on farming at sea, such as monitoring growth and infrastructure at algae and oyster farms. Safeguarding society includes surveilling traffic, fishing, infrastructure in harbors and coastal regions. Lastly, collecting ocean data, monitoring climate change events as well as eventual chemical leakage events at sea is part of the environmental sensing use case. Using the sensor and communication equipment, SAM can autonomously collect the wanted data.



SAM to the left and a close up of the SAM nose-cone to the right.

Additive Manufacturing

Additive manufacturing is commonly referred to as 3D printing and it is a cost-effective manufacturing alternative for prototyping and low volume production of end-user products. Specific guidelines and requirements exists for each specific 3D printing method, this project have been focused on additive manufacturing using plastic materials and specifically the two technologies Selective Laser Sintering (SLS) and Multi Jet Fusion (MJF) as printing method.

Product Development Process

To develop a new design for the nose-cone using additive manufacturing, a product development methodology was used, which started off by deep diving in user and technical needs related to the AUV. The needs were translated into more technical specifications, which was used as the base for developing design concepts solving the AUV related challenges. The concepts were validated and tested by simulations and further development and prototyping was made for a final concept.

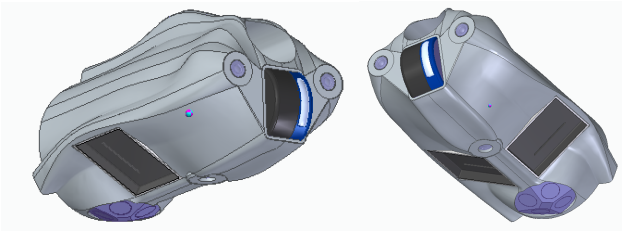
Testing and Results

The developed AUV nose-cone design has an optimized shape and provides sealed placements for sensors and communication equipment, ensuring a high level of sensor functionality. The design pleases the user needs found in the product development process. The concept design of the model was tested and validated by consulting professors and experts, simulations and calculations were also performed throughout the project.

The conclusion of this project is that it is feasible from a technical, economic and environmental perspective to use an additive manufactured nose-cone design for SAM AUV, based on the findings

in this project. Further simulations and testing of the model and material needs to be performed though, to assure a viable product.

If successfully implemented for SAM AUV, the nose-cone design will be the first none flooded plastic MJF printed nose-cone design on the market.



The final developed nose-cone design for SAM.

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