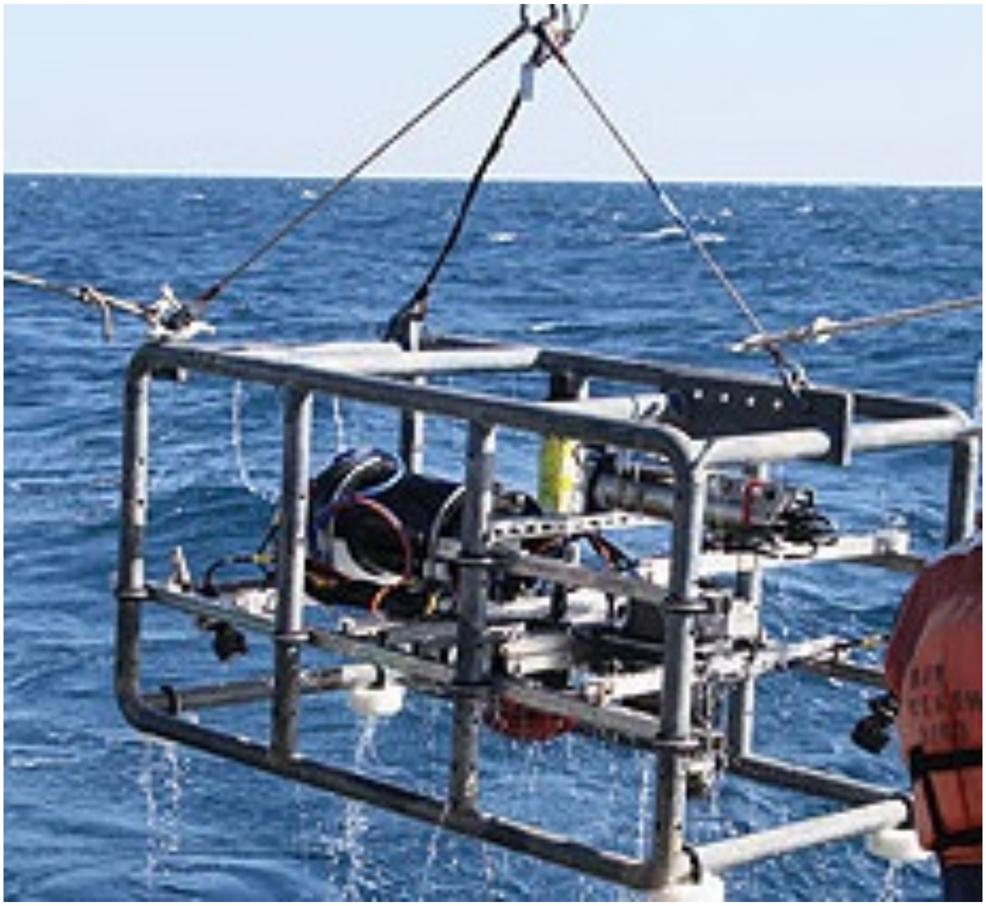
Modular Instrument Lander and Equipment Toolsled v2.0



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Abstract

To determine which direction this project needs to go in, it is first necessary to gather background information from not only the sponsor but from previous Tethered Operated Vehicles (TOV). Once information from the sponsor is gathered, a Needs Assessment can be determined and a path for the project can begin. To better define the project itself, a deeper understanding of what a TOV is must be accomplished. To do this, multiple meetings with the sponsors and research on previous TOV's have been done. To further the project from here, there needs to be an approach on the analysis of different TOV to gather the best aspects of previous designs and our designs.

1 Introduction

The Earth, Ocean, and Atmospheric Science (EOAS) group at Florida State University is interested in updating their current tethered underwater vehicle to a smaller, lighter, more modular, able to orient itself, and easily moveable design. The design currently is a large rectangular prism which contains 15 pieces of equipment to collect data and house needed electronics. This TOV needs to be able to withstand pressures of 2000 meters deep and be impact resistant to possible rocks on the ocean floor. In order to do this, research must be done on previous TOVs and the best aspects from each- shape, inside design, material- can be implemented into our design. To determine an optimal volume and equipment set up within the housing, there must be a standardization when analyzing the potential designs.

2 Project Definition

2.1 Background research

To create a TOV, it is necessary to determine the optimal design for underwater use. Florida State University (FSU), University of South Florida (USF), University of Mississippi (UM), and other non-university companies have designed TOV's to best suit their needs. After gathering information from non-university companies, it was clear that their budget was larger and therefore, had more access to resources. However, they all seemed to have an outer casing housing the electronics which could possibly lend to a longer design in the future but is also much more expensive.

FSU, USF, and UM have all made previous TOV's. FSU currently has a TOV which is made of galvanized steel piping. The rectangular prism shape has dimensions of 3 feet by 6 feet by 3 feet and can be seen below in figure 1[3]. They have approximately 15 different pieces of equipment that they attach to the frame when the TOV is taken out for cruises. This TOV is towed behind a boat and it cruises at about 2000 meters below the surface.

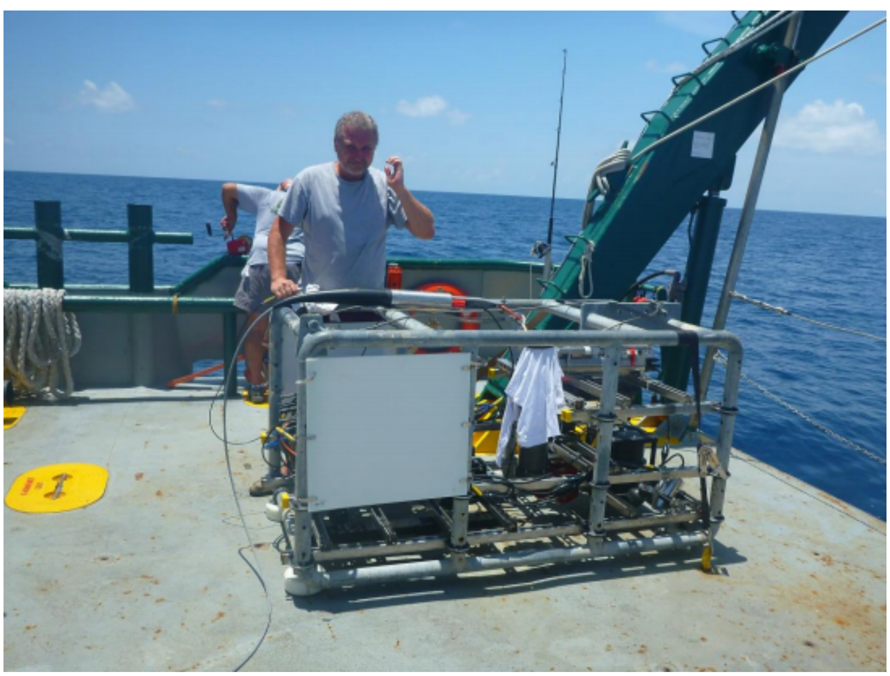

Figure 1: FSU design

USF has a small TOV called the C-BASS (The Camera-Based Assessment Survey System) which can be seen below in figure 2[2]. This smaller vehicle may require fewer parts which would make the vehicle lighter and easier to handle. Its shape and added surfaces may make a more hydrodynamic shape and aid in keeping the vehicle level while underwater. This vehicle is designed to withstand "up to 250 meters of water, but with modifications can be used much deeper"[2.]

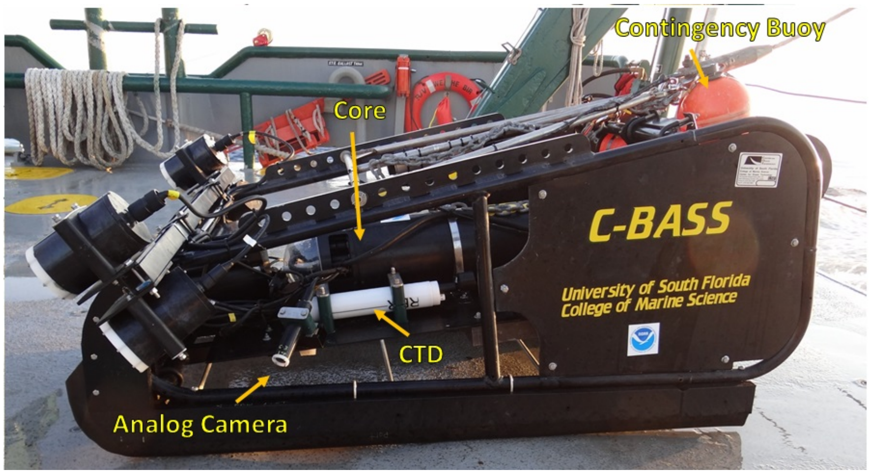

Figure 2: USF deisgn

UM on the other hand has a cylindrical design, Figure 3, the first of its kind. Although this is a very different shape from those previously seen, its analysis could give insight on better potential options for the inside modeling of the equipment. The UM team also had more necessary data collecting equipment than the USF team, about the same number of pieces of equipment that the FSU group needs, from physical observations.

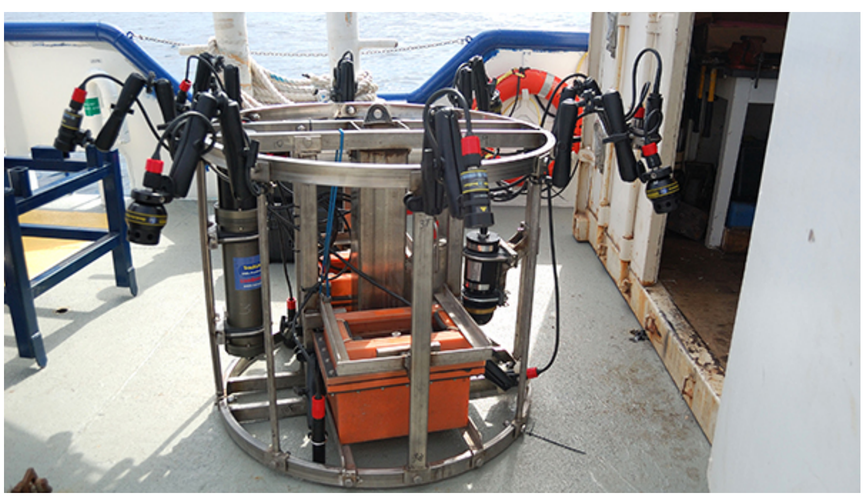

Figure 3: UM design

Although many designs do seem similar to the aforementioned non-university companies, there has been research on underwater simulations for these designs. Updating it for what is necessary for FSU's TOV could potentially help better understand underwater conditions. On top of this, the oceanography lab has an available underwater environment which allows test models of designs to be tested.

2.2 Need Statement

The sponsor for this Modular Instrument Lander and Equipment Toolsled v2.0 (MILET-2) project is the Earth, Ocean, and Atmospheric Science group at Florida State University. Currently, they have a tether-operated vehicle. Their TOV is 6 feet long, 3 feet wide, and 3 feet tall and is made of galvanized steel piping. Many sensors, cameras, lights, etc. have the ability to attach to the TOV. The TOV is currently able to be pulled behind a boat via a tether and collects data at a depth of about 2000 meters under water. The current TOV has too much empty space, is too heavy, is difficult to move around, and cannot be oriented once submerged.

2.3 Goal Statement & Objectives

Design an improved TOV frame that is smaller, lighter, more modular, and has the ability to be oriented underwater

Objectives:

- Minimize the weight of the new frame
- Minimize the size of the new frame
- Must be more easy to transport and manipulate
- Have a orientation system

2.4 Constraints

Constraints:

The total cost may not exceed $10,000

Must be modular

Made of corrosion resistant materials

Ability to hold all necessary equipment

The frame must be pressure resistant (minimum of 2000 meters)

2.5 Methodology

Initially the most important aspect of the project is to get an in depth understanding of what is needed. This includes gathering information on equipment such as weight and dimensions. A house of quality (HOQ) diagram was created to determine the most important engineering characteristics to keep in mind during the design and analysis of the project. It can be seen in table 1 below. It ranked the most important engineering characteristic as material, followed by size, weight, hydrodynamic shape, cost, and strength.

Table 1: House of Quality Diagram for MILET-2

		Engineering Characteristics					
		Cost	Weight	Strength	Hydrodynamic	Size	Material
Customer Requirements	Importance to Customer						
Smaller than current TOV	10					10	
Lighter than current TOV	10		10			6	7
Longevity	7			10			7
Water Resistance	10						10
Cost	8	10				4	6
Ease of Movement	8		8		4	7	
Modularity	10						
Orientation Ability	4	6	3		7		
Level Towing Angle	6				10		
Score (CI x EC)		104	176	70	120	248	267
Relative Weight (Score/Sum)		10.5583756	17.8680203	7.10659898	12.1827411	25.177665	27.106599
Rank		5	3	6	4	2	1

Once this is accomplished, extensive background research must be done to understand previous designs and how these designs performed underwater using moment, drag, and centroidal analysis. Once the best aspects of each design are determined, we can integrate it with personal designs to determine the best design possible for this project.

After background research is finished, new designs need to be drawn and have its own analysis done similar to the previously mentioned analysis on already done designs. After these new designs are approved by the sponsors and problems that arise are fixed, a smaller scale model will be built to test how the shape will behave while being towed in large depths in a tank in the lab. Again, any issues that arise will be fixed. When a best model is tested, a final design will be built and tested in St. Petersburg.

2.6 Schedule

Since this project is still in the beginning stages, we have not concluded a schedule we would like to follow. However, it should be completed by the next report.

3 Conclusion

In conclusion, Florida State University's Earth, Ocean, and Atmospheric Science group currently have a tether-operated vehicle that they would like to update. Their current vehicle is made of galvanized steel, which makes it very heavy. The large frame is welded together so it is difficult to transport. Once it is in the water, it cruises at an angle and there is no way to orient the vehicle. The EOAS group has recruited a design team to design a new TOV frame. This new TOV has several constraints. The total cost may not exceed $10,000; the frame must be modular while also having the ability to hold all of their equipment. They have requested it to be lighter than their current frame (about 800 pounds), while remaining corrosion resistance and pressure resistant (minimum of 2000 meters).

In order to do this, research must be done on previous TOVs and the best aspects from each shape, inside design, material, etc. can be implemented into our design. To determine an optimal volume and equipment set up within the housing, there must be standardization when analyzing the potential designs. A material for the housing must be determined. For instance, although galvanized steel is stronger than aluminum 6061, aluminum is much lighter than steel but may not be able to hold all the equipment or resist the great amount of pressure it will experience. If an orientation system is implemented it will be electronic and take away from the power needed for the camera, lights, and lasers.

4 References

[1] "The Camera-Based Assessment Survey System (C-BASS) - USF College of Marine Science." *The Camera-Based Assessment Survey System (C-BASS) - USF College of Marine Science*. N.p., n.d. Web. 24 Sept. 2015.<http://www.marine.usf.edu/news/the-camera-based-assessment-survey-system-c-bass/176-the-camera-based-assessment-survey-system-c-bass>

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[3] "Deep-C Consortium: Voices from the Field: Geomorphology Cruise aboard the RV Weatherbird II." *Deep-C Consortium: Voices from the Field: Geomorphology Cruise aboard the RV Weatherbird II*. N.p., n.d. Web. 24 Sept. 2015. <http://deepcconsortium.blogspot.com/2013/06/geomorphology-cruise-rv-weatherbird-ii.html>