The Bathymetry ROV

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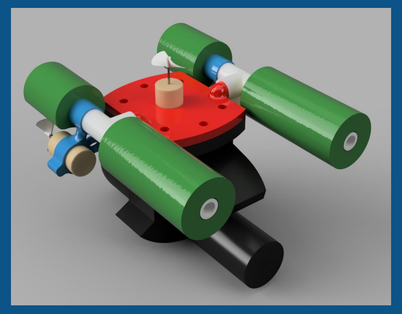
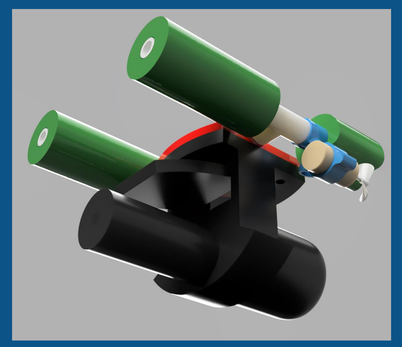
Project Overview

A bathymetric survey is when SONAR equipment is used to map the depths and shapes of underwater terrain. Typically done on large boats or USVs on the surface, these surveys are important for many scientific and commercial applications. However, an ROV with bathymetric capabilities could provide higher–resolution maps. Just like how a camera can take better photos when it's closer to the target, a SONAR device can create maps with higher accuracy when closer to the sea floor. Also, the ROV could check on underwater infrastructure, a difficult task without getting a human diver involved. For our project, we designed a SeaPerch ROV with a Norbit – iWBMSh STX, a high–end turnkey multibeam SONAR system.





This is the Bathymetric SeaPerch ROV that we designed. The red piece on top would be 3D printed. It would hold the SONAR system below it, the vertical thruster in the middle, and the flotation and horizontal thrusters on either side.

Approach

First, we had to decide which technology we would use to be able to "see" underwater. LiDAR, RADAR, and SONAR use lasers, radio waves, and sound, respectively. Radio waves used for RADAR get absorbed into the water, so RADAR isn't an option. While LiDAR is more accurate than SONAR, it has a hard time when the water is not clear. That leaves SONAR technology. The main problem with SONAR is that it loses accuracy with depth. The solution would be an ROV that could bring a SONAR device closer to the floor to allow it to collect more accurate data.

Next, we had to find the best SONAR system for our use. We chose the Norbit –iWBMSh STX due to its light weight, compact design and extremely high–resolution capabilities.

Discussion and Reasoning

The Norbit –iWBMSh STX features <6mm (0.24 in) range resolution. Range resolution is being able to distinguish between two or more close targets, and it is calculated by dividing the speed of sound in water by twice the SONAR bandwidth (sampling rate). However, SONAR beams spread out as they travel further, increasing the spacing between the data points at lower depths. Sudden vessel movements due to waves can also hurt the quality of the map. A SeaPerch ROV can overcome these challenges because its motion can be precisely controlled, waves don't affect it underwater, and it can get close to the sea floor, decreasing the beam spread, decreasing the distance between the data points that the SONAR collects.

Sources

NORBIT. (2020). *Norbit – iWBMSh STX – high–end turnkey multibeam ...* NORBIT MULTIBEAM SONAR SYSTEMS. https://norbit.com/media/PS– 170005–9_iWBMSh–STX_12007–APBDD4_A4.pdf

What is a bathymetric survey?. McLaren Engineering Group. (2020, July 22). https://www.mgmclaren.com/blog/bathymetric–survey/

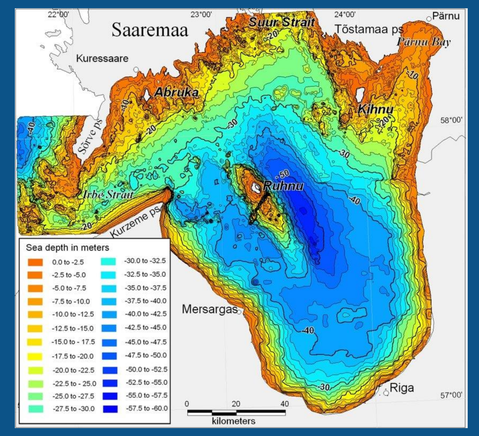
Background and Rationale

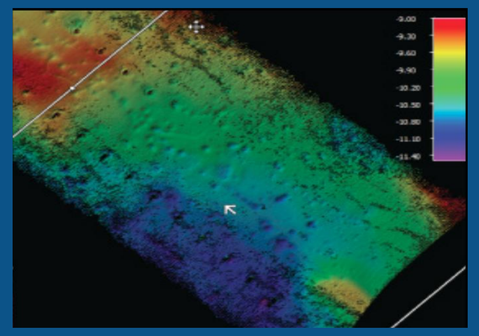
A few years ago, after driving his SeaPerch ROV at Lake Anna, Hayden went swimming and sliced his toe underwater on an old, rusty hook. The lake water was murky, with depth visibility around 3–4 feet. Thankfully, he already had his tetanus shot, and he was able to dig up the hook to prevent future injury. That got him thinking how the problem could have been prevented in the first place. There could also be other unseen threats in the lake. Would it have to take an injury to find them? Could SONAR equipment be used instead?

Upon further research, we found many other use cases for high–resolution bathymetric surveys, both scientific and commercial. Observing changes over time to understand the effects of humans on an environment, and identifying potential locations for underwater infrastructure are just a few examples.

Next Steps

There are a few things we haven't taken into consideration for this Bathymetric ROV. First, there would need to be some way to monitor the position of the ROV. If the SONAR system doesn't know its position, it won't know how to arrange all the data points it collects to make an accurate map. Also, the ROV's operators would need a way to know the ROV's location in the water. Finally, the ROV would need to be tether–less. Having a tether hundreds of meters long is unwieldy and difficult to manage. This could be solved by incorporating a battery and signal antenna to make it wireless.





These pictures are what bathymetric maps look like. They show the depth and shape of the sea floor.

Monitoring undersea infrastructure is cheaper, more efficient, and more thorough with a robot!

This is the NORBIT – iWBMSh STX SONAR system.