

AUTONOMOUS UNDERWATER VEHICLES IN SURVEYING

By Jeran S. Hopfe, S.I.T.

INTRODUCTION

If you were asked to perform a topographic survey of the ocean floor, how would you collect the data required? Most surveyors are familiar with the differences between Aerial LiDAR, UAV-based photogrammetry and LiDAR, and terrestrial data collection, but it is uncommon in our profession to work at depth on the ocean floor. In this tech talk, we will discuss what an Autonomous Underwater Vehicle (AUV) is, and what differentiates it from what might typically come to mind when we think of SONAR surveys.

Texas boasts both the most seaward coastal boundary of any state in the union, and rich natural resources within this coastal zone. This means that a Texas surveyor could find themselves in a scenario where they must measure the sea floor at depth, whether this be for quantity calculations during dredging operations, channel depth verification, or obstruction detection, among other things. When presented with this problem, SONAR is usually known to be the measurement tool of choice, but what is used to collect this data, and what accuracies should we expect? What is the advantage of an AUV over another approach, such as a towed side scan sonar “towfish”?

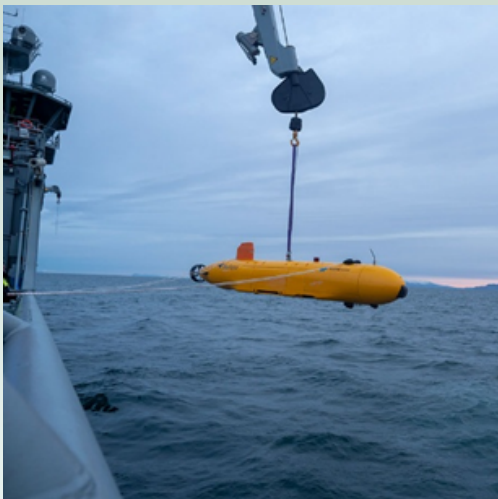


Fig. 1: AUVs can vary dramatically in size, depending on depth, portability, payload, and mission length requirements.



WHAT IS AN AUV?

To think about it simply, if a plane-mounted aerial LiDAR survey was likened to a ship-based SONAR survey (either towed or hull-mounted), an AUV survey would be most like a UAV (drone) survey. AUVs use pre-planned missions to collect high-resolution data along the ocean floor at depths up to 6 km (3.7mi). These submersibles are unmanned and do not require a direct tether to a ship or a human operator to “drive” them around; in much the same way as a UAV uses flight missions to collect aerial data in a specified area, an AUV will collect underwater data. Equipped with advanced sonar and inertial navigation systems, these vehicles can collect high-density bathymetric and seabed data with remarkable efficiency and precision.

AAUVs can collect much more detailed information about the ocean floor than a surface vessel, since they are closer to it, “flying” much closer to the bottom (~80-160 feet), and avoiding obstacles autonomously. They can also navigate much shallower ecosystems than would be possible for these vessels. By contrast, a “towfish” or hull-mounted SONAR system is unable to avoid obstacles and must be used at depths designated as safe for those systems. In addition to the denser SONAR scans collected, AUVs can collect high-resolution mosaiced imagery of the ocean floor, lending to their usefulness in inspections of subsea infrastructure and wreckage sites.

Varying in size from the size of a coffee table to the size of a bus, AUVs can autonomously perform missions from days to weeks in length, with some being solar chargeable. Data is stored onboard the AUV until it surfaces and transmits its data to the ship monitoring its location. Accuracy of data varies between AUV models and hardware specifications, but when you consider that navigation must be primarily achieved through use of an IMU while underwater since GNSS is not available, it is remarkable that the IHO S-44 (International Hydrographic Organization) standard of +/- 10 cm (0.33 ft) is achievable at all in specialized areas.

USE CASES

AUVs can be used in a variety of applications, including port and navigation channels, bridge crossings, utility corridor mapping, and environmental monitoring. They can be utilized to ensure proper depths are maintained through shipping channels, monitor thalweg movement, riprap displacement, sediment accretion and erosion, and can be used to analyze storm impacts. When laying utilities, AUVs can provide valuable data for route selection, as-built verification, and ongoing status monitoring. At a global scale, a fleet of AUVs have been used to search over 85,000 sq. mi. of ocean floor for the remains of Malaysia Airlines flight MH370, which disappeared on March 8, 2014, with more work planned for the future.

WHY THIS MATTERS

As Texas infrastructure expands along coastal and inland waterways, surveyors who understand both terrestrial and marine workflows will be increasingly valuable. Bridge replacement, dredging, flood control, coastal restoration, and utility corridor projects all benefit from professionals who can bridge the gap between land and hydrographic surveying. In many respects, AUV technology represents the marine equivalent of the drone revolution that has already reshaped land surveying.

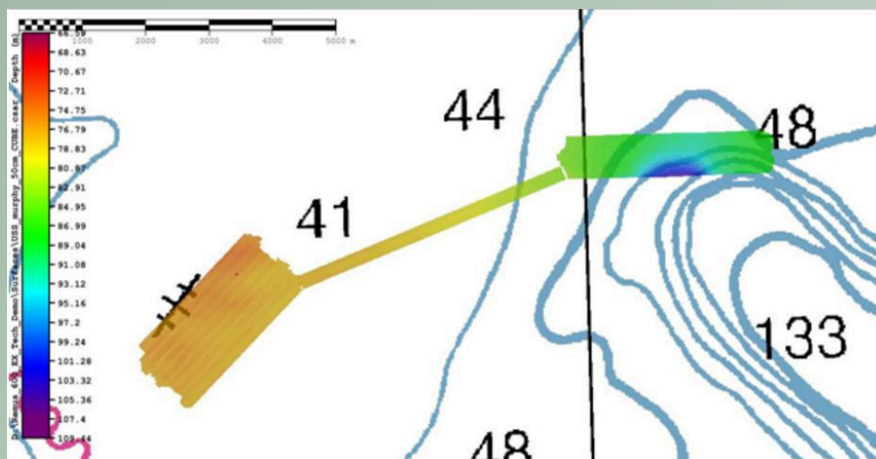


Fig. 2: EM3002 multibeam bathymetry collected over the head of Hudson Canyon.

“THE TOOLS AND ENVIRONMENT MAY DIFFER, BUT OUR PROFESSIONAL RESPONSIBILITIES REMAIN THE SAME.”



ABOUT THE AUTHOR

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