Lesson I. Oceanographic Research, Gathering Data in the Field

Ocean-going research vessels

How do we get information about the things we want to study in the ocean? One of the ways that we can get information is by actually going out to sea on ships. There are several different sizes of ships used for oceanographic research. The Florida Institute of Oceanography, located on the USF campus, primarily uses a 71' vessel called the *RV Bellows*. This is considered one of the smaller ships. An example of a medium sized ship would be the 274' *RV Atlantis* built in 1997. *RV Atlantis* is owned and operated by The Woods Hole Oceanographic Institute, connected with the Massachusetts Institute of Technology. Texas A&M University uses a 470' ship called the *RV Sedco/BP* for their research in the Gulf of Mexico. Obviously, the larger the vessel, the more equipment and scientists it can hold and the longer it can stay out at sea gathering research.

Harsh Environments

Scientists do not always encounter clear conditions when "at sea". Often they endure harsh conditions, so it is important that the equipment be sturdy. Ships and instruments must be carefully maintained while they are being utilized for research. Sea-water is a corrosive medium and can quickly destroy valuable equipment. Some conditions that may interfere with research include: surface weather such as storms, working in very cold temperatures at high latitudes, significantly increased pressure on the instruments as they are lowered deeper and deeper into the ocean and motion sickness.

Underwater robots: Autonomous Underwater Vehicles (AUVs)

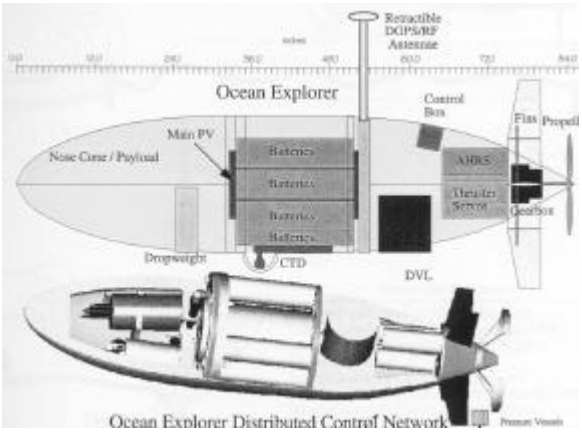
Advantages

The autonomous underwater vehicles (AUVs) developed at USF are smaller and easier to operate than research vessels. They are relatively inexpensive to build and maintain: the average cost to build each unit is $70,000. The instruments that go on the AUV can cost from $5,000 to $100,000 each. The operation cost of an AUV at sea is approximately $1000 per day.

AUVs are extremely versatile because they are scalable, upgradable and reconfigurable, which means researchers can use the same basic design and modify the components. The network used to communicate between the components on the AUV is an off-the-shelf item that is relatively inexpensive.

What do typical AUVs look like?

USF's AUV is shaped like a torpedo and has been nicknamed the "yellow submarine." It is 7-10 feet long, 21 inches in diameter, and weighs between 440-660 lbs. AUVs are streamlined with a hydrodynamically designed hull to minimize drag. Compare USF's yellow submarine's measurements to the British Autosub AUV, which is 23 feet long, 3 feet in diameter and weighs 3300 lbs! Or the Woods Hole REMUS AUV that is 52 inches long, 7.5 inches in diameter and weighs 66 lbs!



Ocean Explorer (modular design!!)

How do they work?

The AUV tail hull section is the propulsion unit, while the forward section is designed for mission-specific research instruments. The cavity of the AUV is flooded with water to help equalize the pressure with the water that surrounds it. All of the instruments inside are sealed in specially designed pressure vessels. Autonomous underwater vehicles have a computer on board that works with intelligent distributed control (IDC) technology to steer the AUV and collect oceanographic research data. IDC technology has become common in the AUV industry; however, its applications are by no means limited to the marine environment.

In general, IDC allows several instruments or control elements to be connected together in a simple, yet versatile network. Each connect element (called a node) can communicate over the network, and each can contain some intelligence (software) that allows it to operate independently should the network fail.

How are AUVs used or what can they do?

USF's AUV can dive up to 600 meters, but works best at 450 meters. It has a range of 20 nautical miles and an

endurance of 5-8 hours. It moves at a speed of 2-5 knots. It is battery powered, with a battery capacity of five working hours. It takes five hours for the battery to recharge. AUVs are neutrally buoyant so they don't sink!

Primarily AUVs carry sensors that are designed for very specific tasks. They can:

- look at small particles in the ocean
- look at temperature, salinity and other physical parameters associated with the water
- detect chemical pollutants
- study behavior of ocean currents
- detect or find weapons in water. The weapons could be small (guns and knives) or large (military weapons)

Student Information Sheet Lesson 1

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How do they work?

Autonomous underwater vehicles function with an internal computer. The tail hull section contains most of the dedicated components, while the forward section is free for mission-specific components. Intelligent distributed control technology is proven beneficial for development of instrumentation systems utilized in oceanographic research. The versatility of the technology has allowed quick implementation of solutions for control and data collection, thus allowing more time to be spent on development of measurement systems. The technology, born of needs in industry, is become in more prevalent and is by no means limited to marine applications.

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