# AOSN MURI: Development of a Network of Virtual Moorings

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## LONG-TERM GOAL

To create and demonstrate a reactive survey system, capable of long-term unattended deployments in harsh environments. We refer to such a system as an Autonomous Ocean Sampling Network (AOSN). This project is to develop a cost effective means to observe the ocean continuously over many months with vehicle ranges of several thousand km.

## OBJECTIVES

The technical objective of this project is to develop a small network of comparatively inexpensive autonomous vehicles that can collect temperature and salinity profiles continuously from the upper 2 km of the ocean while either maintaining their geographic positions or surveying along a desired track. This network is to report measurements in near real-time and be controllable from shore. Vehicles are designed to profile vertically over 2000 km. The horizontal range is to be 10,000 km and with mission duration of several months.

## APPROACH

Our approach is to design, construct, and test a prototype battery-powered ocean glider carrying temperature and conductivity and sensors. This vehicle, dubbed the Virtual Mooring Glider, will be able to glide at horizontal speeds up to roughly 0.25 m/s for several months. To achieve the desired mission life, the vehicle design incorporates a low-drag fairing with wings attached, a nearly neutrally compressible pressure hull, and low power electronics. The overall power consumption of the vehicle is a fraction of a watt.

The glider dives from the sea surface along a glide slope chosen to make the desired horizontal and vertical progress through the ocean. At a selected depth as deep as 2 km, vehicle pitch is reversed and ~200g of oil is pumped into an external bladder to make the vehicle glide up to the surface. There, it extends an antenna stalk to receive a GPS navigation fix and, optionally, to send data and/or receive commands via cellular telephone before making its next dive. The glider steers by moving its battery pack in order to effect changes in vehicle pitch and roll. It maintains glide slope and compass heading underwater between navigation updates at the sea surface.

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Gliders are intended to be reusable and relatively inexpensive to build and maintain. They are small (1.8m in length, 1.0m in wingspan) and lightweight (52 kg) so that they may be launched from small boats.

## WORK COMPLETED

A first prototype vehicle has been designed, constructed, and has undergone preliminary laboratory and field tests, including untethered dive cycles in Puget Sound. See Figure 1.

## RESULTS

The prototype vehicle glides stably and is able to achieve glide slopes of approximately 1:5. It is able to attain the desired speeds with the anticipated buoyancy deficit or excess of roughly 100g. Full autonomous operation has been achieved in Puget Sound, communicating via the local cellular telephone network. The glider obtains a GPS fix then calls the computer aboard the research vessel to download its most recent profile data and ask for changes in its operational parameters (new target coordinates or dive cycle duration, for example). A Seabird CTD has been incorporated on the vehicle and tested. Testing will continue in inland waters until the anticipated operation of worldwide cellular telephone service in late 1998 makes open ocean missions practical.

## IMPACT/IMPLICATIONS

The expected impact of successful development of gliders on oceanography is that hydrographic profile surveys can be made at much lower cost than is now possible using moorings or ships. The ocean can then be sampled much more densely and over longer duration than is conventionally practical. The expected cost of 1 m resolution joint temperature/salinity profiles from the surface to 1 km depth at an arbitrary location, reported in near real-time, is under $20.

## RELATED PROJECTS

This project is part of the Multidisciplinary University Research Initiative (MURI): “Real-Time Oceanography with Autonomous Sampling Networks: A Center for Excellence”

## REFERENCES

See the MURI-AOSN web site: http://web.mit.edu/seagrant/www/MURI_home.html

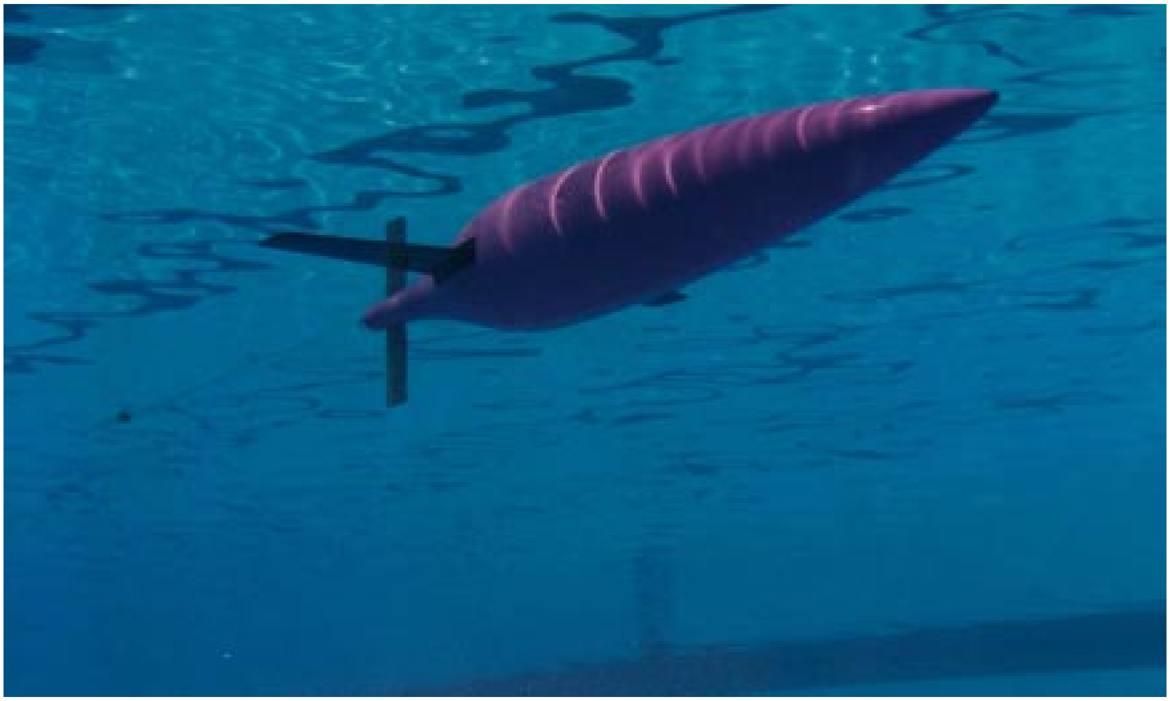

*Figure 1. The prototype Virtual Mooring Glider vehicle gliding in a seawater swimming pool, viewed from below. The ÿberglass fairing provides a low-drag shape enclosing the pressure hull. The antenna stalk trails behind the vehicle and is exposed by pitching the vehicle nose down when at the sea surface.*