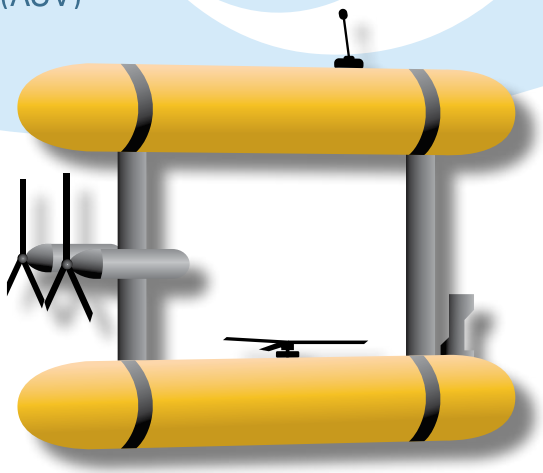
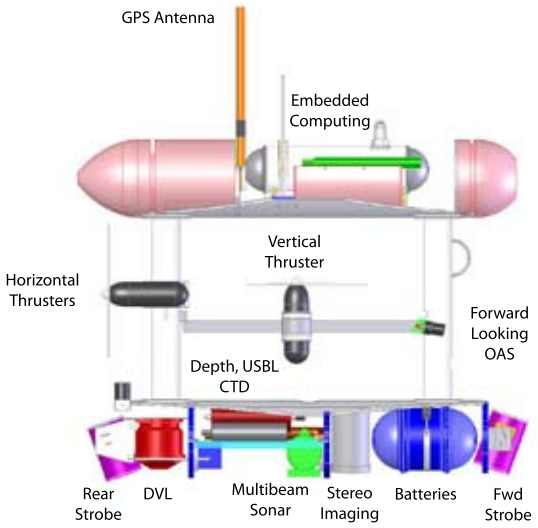
IMOS Integrated **Marine Observing** System

FACILITY 5: Autonomous Underwater Vehicle (AUV)



Autonomous Underwater Vehicles (AUVs) are becoming significant contributors to modern oceanography, increasingly complementing traditional survey methods. While very large-scale surface processes can be addressed by remote sensing and ship-borne systems, characterisation of many marine processes requires the ability to make observations at high resolutions in close proximity to the seafloor. The ability to conduct geo-referenced, high resolution, repeatable surveys of marine habitats – particularly those beyond diver depths – represents one of the key recent advances in AUV systems.

The objective of the IMOS AUV Facility is to provide access to and operational support for AUV systems for the marine science community in Australia. The Facility currently operates an AUV designed for high-resolution seafloor imaging. This vehicle is available to support marine research based on a competitive application process.



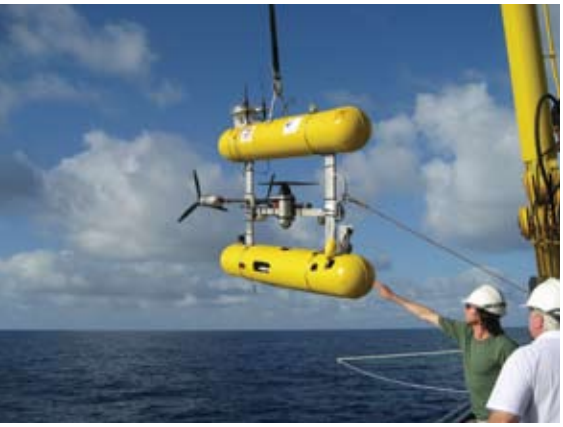


Figure 1. The AUV Sirius with fairings removed (above) and retrieving the AUV after survey work (below)

The AUV and instruments

The Autonomous Underwater Vehicle (AUV) Sirius is designed for undertaking high resolution benthic optical and acoustic imaging work. This experimental platform is a modified version of a mid-size (200 kg) robotic vehicle called SeaBED built at the Woods Hole Oceanographic Institution. Its maximum operating depth is 700 m. The submersible is equipped with high resolution stereo cameras and strobes; a 330 kHz multibeam sonar; a 1,200 kHz Doppler Velocity Log (DVL) capable of collecting water-column velocities in addition to vehicle velocity over ground; a depth sensor; a fluorometer that measures coloured dissolved organic matter (CDOM);chlorophyll-a and backscatter; and a conductivity/ temperature sensor.

A variety of additional navigation sensors, including GPS, and Ultra Short Baseline (USBL) acoustic positioning, enable precise tracking of the vehicle allowing survey data to be geo-referenced at high precision. All data is time-stamped and logged on-board the vehicle during operation.

AUV Data

Data collected by the AUV consists of stereo imagery, multibeam sonar, vehicle navigation and water chemistry data. All data products are precisely geo-referenced using state-of-the-art terrain-aided navigation algorithms. Optical imagery is delivered as individual high-resolution, color-corrected images (geotiffs) and also in processed form, as mosaics and 3D seafloor reconstructions.

Applications of AUV data

Optical imagery derived from the AUV has been used primarily to document benthic habitats, particularly beyond diver depths. Precise geo-referencing of the data products enables data derived from the AUV to complement and enhance the value of data derived from other assets, e.g., ship-board multibeam. The AUV has been deployed in collaboration with scientists from a variety of Australian and international institutions at various sites around Australia:

- Australian Institute of Marine Sciences: Benthic habitat assessment beyond diver depths, Ningaloo Reef, WA.
- University of Sydney, James Cook University, CSIRO, University of Oxford, University of Edinburgh: documentation of drowned

Figure 2. The AUV in action, surveying Cuttlefish spawning grounds. © Roger Hanlan.

shelf-edge reefs at multiple sites along the Great Barrier Reef with application to predicting the response of modern reef systems to climate change.

- Department of Environment and Heratage, SA: Benthic habitat documentation in support of potential declaration of a marine park, Sir Joseph Banks Island Group, SA.
- Marine Biological Laboratories (Woods Hole, USA), National Geographic: Non-disruptive photo-documentation of cuttlefish nocturnal camouflage, Whyalla, SA.
- Tasmanian Aquatic and Fisheries Institute, Tas: Biological assemblage characterisation of rocky reef systems in deep shelf waters beyond diver depths in support of physical surrogate development for remote (acoustic) biodiversity mapping, Tasman Peninsula and Huon MPA, Tas.

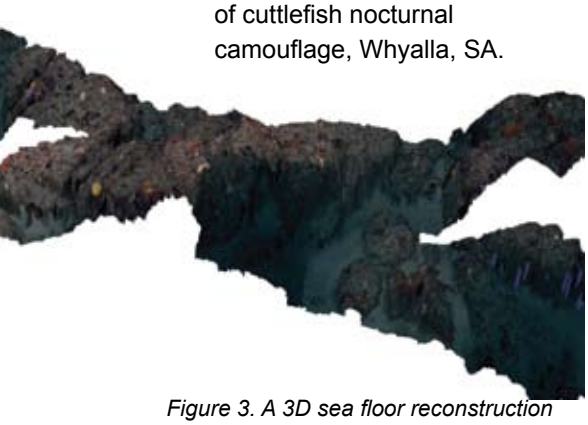


Figure 3. A 3D sea floor reconstruction of fringing reef from Tasman Peninsula, Tasmania. This includes photographs from 2 passes over the same object.

Focus and priorities

The focus of the AUV facility is delivering high-resolution, precisely geo-referenced imaging products. In addition, the facility is working to enhance capabilities in two principal directions: (1) image processing for automated habitat classification, and summary abundance and coverage estimates; (2) enhanced survey capabilities to enable repeatable transects of the seafloor for long-term monitoring applications.

Partners

- Australian Institute of Marine Sciences
- Centre of Excellence for Autonomous Systems, University of Sydney
- CSIRO Marine and Atmospheric Research
- Defence Science and Technology Organisation
- National Geographic James Cook University
- Sydney Institute of Marine Science
- Royal Australian Navy
- South Australia Department of Environment and Heritage

Figure 4. A 40 image 10 m long mosaic of sponge beds in 80 m deep water off Ningaloo Marine Park, Western Australia.

www.imos.org.au

IMOS Integrated Marine Observing System

An Australian Government Initiative
National Collaborative Research Infrastructure Strategy

More information

IMOS AUV Facility http://imos.org.au/auv.html

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