

ABSTRACT FORM

Project Title: 003 AUV Docking

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Project Description:

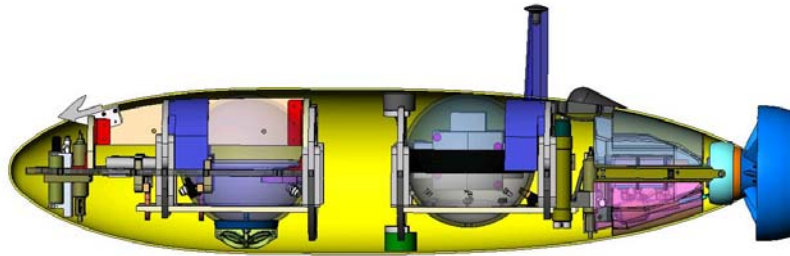
AUV Docking
James G. Bellingham

This effort would continue the existing AUV Docking project, with the objective of developing an AUV docking capability which can be used with cabled observatories and extended to mooring-based observatories. A simplified version of MBARI's CTD AUV would be used as the docking vehicle. This project is central to realizing the full power of the seafloor observatories under development at MBARI. Seafloor cabled systems distribute power and communication to the interior of the ocean, while mobile-platform observation networks provide dense, adaptable coverage. The docking system enables the two approaches to merge, providing an AUV access to seafloor observatories power and communication infrastructure and extending the reach and flexibility of the fixed infrastructure.

Why is a new AUV docking project required, when docking has been on the books at MBARI for several years? The short answer is that MBARI engineers have been unavailable until very recently, and thus the project has been on hold for most of its existence. Even in 2004, the project was put on hold from mid-winter to June due to staffing demands of other activities.

In the past months of activities, the project has focused on the following issues:

1) What is the minimum configuration AUV that could be used for docking? A simpler vehicle is attractive from both a reliability perspective and to keep costs down. At present, we estimate a vehicle cost on the order of 300K, not including docking.



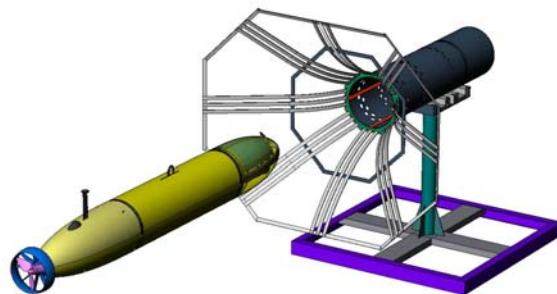
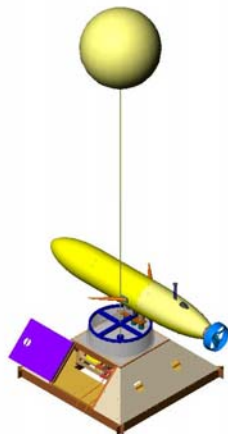
Docking AUV:
leveraged off of
existing AUV design,
but with modularity
requirement removed.

2) What system would enable the AUV to home on the dock? Ultrashort baseline navigation has proven highly successful in earlier docking systems. We are exploring use a new device, called a 'acoustic vector sensor' which might provide a low cost solution, as well an off-the-shelf system produced by Linkquest which is significantly more expensive.

3) What are reasonable expectations for homing accuracy? Analysis of the performance of the existing system tells us that performances as good as 20 cm vertically, and 40 cm horizontally might be reasonably expected, thus providing an initial bound on dock capture aperture.

4) How might power and communication connections be established between the vehicle and the dock? Non-contact methods are preferred, as off-the-shelf underwater connectors require careful alignment, have high insertion forces, and are both heavy and expensive. Inductive power transfer was used in earlier docking system work, and is the preferred option for the MBARI docking effort. For communications, the use of 802.11g, a standard wireless protocol, is being explored.

5) What dock concepts are being considered? Cone, pole, and tail-hook capture docks are all being considered.



6) What failure modes are being mitigated? Beyond the more obvious issues addressed in previous docking work such as missed approaches and undocking

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problems, the project is working on failure modes identified but not resolved earlier. These include failures caused by impact of the vehicle with the dock, and failures due to coordination problems between the dock and the AUV.

The timeline for the extension of the docking project would result in a working dock sometime in 2006 or 2007. This ambiguity will be resolved before the phase I proposal, and will depend on down-selecting the docking system approach (a Concept Review will be held). An aggressive schedule for this project is quite important, as several other docking efforts were initiated and made progress while this effort was on hold. FAU's docking efforts, targeting the Bluefin 12" vehicle (a 300 or 1000 m system) are waiting for additional ONR funding, but the REMUS (100 m rated vehicle) docking system built for the Navy SEALs appears to be nearly fully function. Neither of these provides a solution for deep-water or for MBARI vehicles, but they make clear that the field is becoming competitive.

The project team for this effort includes: Brett Hobson, Jon Erickson, Rob McEwen, and Lance McBride. Steve Rock and Hans Thomas are contributors, as are the members of Jim Bellingham's lab group (Thomas Hoover, Mike Godin, and Yanwu Zhang).