

## APPLICATION OF ROBOTIC UNDERSEA VEHICLES TO UNDERWATER DATA CONNECTIVITY

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In the context of an information-based society the ability to reliably retrieve, transfer and process large quantities of digital data in a timely fashion becomes a critical technology issue. Few operating environments place more limitations on our ability to transfer data than underwater: either in the deep ocean or in littoral regions. In the sea, the conductive medium places strict limits upon RF propagation, visibility greatly restricts the bounds of optical transmission and ambient noise, ray-bending and multipath dominate the acoustic environment. In practice, data transfer rates are usually limited to *at most* a few kilobits per second in spite of the technology employed, even under fairly favorable conditions, unless a *hard* connection via a cable is established. However, adverse logistics associated with underwater cables and their associated infrastructure often renders a system concept totally impractical from a technical or economic standpoint, in spite of the ability of the cable to sustain reliable data transfer underwater at a high rate.

In order to circumvent some of these issues, nearly a decade ago the U.S. Navy developed expendable fiber optic microcable (FOMC). FOMC is a tiny fiber optic cable, consisting of a single commercial optical fiber surrounded by a concentric strength-member of fiberglass-reinforced polymer, which can be manufactured inexpensively enough to be thrown away after each use. FOMC can be deployed underwater from a freestanding coil at high speeds and serves to establish a reliable transmission channel which is capable of supporting megabit-to-gigabit per second data transfer rates. Microcable was demonstrated to support high data rate communication requirements for several point-to-point military applications, including torpedoes and UUVs, while exacting a minimal impact upon the logistical and operational capabilities of the system. However, FOMC still could not support the potentially vast number of advanced undersea system architectures which require make-break or network communications without the subsequent development of supporting underwater connectivity technology.

An underwater vehicle is a means for physically establishing the physical connection required for fiber optic data transfer. A small UUV carrying a coil of FOMC launched from a support platform is a good candidate for establishing a fiber optic link between a remote, cooperative data node and the support platform. Signal processing and guidance and control functions are readily remotored to computers aboard the support platform by means of the fiber optic channel during the acquisition phase of the mission; the same FOMC subsequently supports data transfer after the vehicle has docked with the node. Partitioning of hardware in this manner helps to keep the system inexpensive to manufacture and ultimately permits an expendable vehicle to be designed. The *Flying Plug* system, funded by the Office of Naval Research and being developed by NReD, is a developmental prototype of such an underwater communication system. This paper discusses some of the critical technologies which have been developed to support the Flying Plug system.



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