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SeaView Multiplexer Enhances ROV Data Communications

PC-104-Compatible Upgrade Suits Space-Constrained Custom Vehicles, Breathes New Life Into Legacy Equipment

By Matthew Cook • Richard Funk

The ever increasing capabilities of sensors and cameras that can be deployed by ROVs, and the expectations these create, have resulted in a gap between sensor data and the electronics to deliver the data via umbilical fiber link. And with the increasing availability of (and expectation for) HD video, a host of existing ROVs are getting caught without the bandwidth to handle the data produced by available technologies.

This issue is especially acute for both legacy ROVs and space-constrained custom designs, where this "bandwidth gap" can impact the effectiveness and cost justification for the often expensive task of deploying an ROV. The irony is that the fiber-optic cable typically used for tethered ROVs is capable of handling much greater data rates than the electronics on the vehicles.

SeaView Systems (Dexter, Michigan), a provider of ROV services, custom vehicles and hardware, has developed the OmniData multiplexer stack to open new possibilities for compact custom vehicles and to breathe new life into legacy ROV platforms hampered by bandwidth constraints.

Many ROVs provide a data backbone that might support two or three standard-definition cameras and some serial data. Managing the demands of multiple HD video streams or applications, such as multibeam sonar, often requires additional cards in vehicles where space is at a premium or nonexistent.

SeaView's multiplexer and data converter suite were designed to break through this bottleneck with a set of video, serial and Ethernet ports (including RS485-232 conversion) and timing triggers, all on a single card. The multiplexer is part of a family of cards that can be configured based on the needs of the job and available space. For example, in the case of



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Electromagnetic data for a recent shallow-water MEC/UXO survey site.

especially demanding applications, SeaView's multiplexer can be linked with the company's gigabit Ethernet converter and dual channel HD-SDI boards to transmit all the data on one single-mode fiber.

The SeaView multiplexer is designed to the PC-104 form factor to provide pin-compatible replacements for the slower cards used in numerous existing ROV platforms.

Necessity Drives Invention

SeaView Systems performs ROV deployments, ranging from surveys with off-the-shelf ROVs to vehicles that are custom-built from the ground up to meet the specialized demands of complicated work environments. But the demands of both of these types of activities were oftentimes bumping against the same limitations. The sensors to do the job were available. The fiber link had the bandwidth for the data the sensors produced. But the available onboard electronics, designed in the era of SD video, just didn't have the bandwidth or flexibility they needed to take advantage of the HD cameras and additional sensors that are readily available today. For many of SeaView's ROV deployments, the limitations of the communications electronics were proving to be as constraining as the rigors of deepwater.

For example, one deployment required a multiplexer that would enable two HD cameras, multibeam sonars, tooling cameras and the flexibility to add a number of other sensors. It also required fitting them all into a very small pressure cylinder. As they set about designing a solution, SeaView recognized an opportunity. Rather than building up a single-purpose solution, they decided to build the Swiss Army knife of multiplexers. Once they'd decided to address the bandwidth issue, they finalized the board by squeezing in the most useful ports for the broadest range of possible applications. In order to address the needs of multibeam sonars and other high-bandwidth devices such as HD cameras, they also included onboard RS485-232 conversion, which saved the hassle of needing extra hardware for the conversion.

In the course of creating the design, SeaView saw that the PC-104 form factor would make this the obvious choice for upgrading a wide range of existing equipment, which could take advantage of either the higher-definition video or additional sensor possibilities the multiplexer would enable.

Expanded Palette of Applications

An early customer for the product was Tetra Tech (Pasadena, California), an underwater survey company. Their Seattle, Washington-based Survey and Mapping Division deployed the SeaView stack as part of their TEMA (towed electromagnetic array), a tow sled that performs undersea surveys primarily for the detection and mapping of unexploded ordnance (UXO) and munitions and explosives of concern (MEC).

The design constraints of Tetra Tech's TEMA re-

quired it to be small enough to be rapidly transported and deployed from a vessel of opportunity, while still able to provide a comprehensive suite of sensors, lights and cameras. The specification demand for very-high-bandwidth data transfer in a small package presented Tetra Tech with a challenging underwater engineering problem that slotted nicely with the SeaView multiplexer's capabilities.

The ability to multiplex live HD video, still DSLR (digital single-lens reflex) images, and all the data from altimeters, temperature sensors and electromagnetic systems—all on a single-mode fiber cable—made the SeaView multiplexer the only choice for Tetra Tech.

With the flexible capability to deploy such a broad range of sensors using the SeaView multiplexer, Tetra Tech was able to design the TEMA to readily support a wide palette of additional activities from a single platform, including cable and pipeline route surveys, pipeline/cable location and O&M monitoring, search, salvage and debris surveys, archaeological/cultural surveys, and MEC/UXO digital geophysical mapping (DGM).

The data capabilities of the SeaView multiplexer allow adaptation and evolution of the TEMA platform based on the most recent experience and the particular requirements of each deployment. Subsequently proven at real-world



Detected ordnance derived from an instrument verification strip (IVS).

underwater munitions sites, the TEMA has provided Tetra Tech with a fully operational platform, tested and ready to survey in water depths from centimeters to more than 100 meters, and flexible enough to adapt to each new deployment.

A key element of the TEMA's design is an array of three high-sensitivity metal detectors. The arrayed design allows for the detection of ferrous and nonferrous metals, even in close proximity to piers and other structures where magnetometers fail. Thanks to the flexibility of the SeaView multiplexer, Tetra Tech was able to design the TEMA with the ability to send back imagery data; a capability not possible with previous multiplexers. In addition, the TEMA was designed with the goal of interchanging various sensors and monitoring equipment that are all compatible with the high-speed bus provided by the SeaView multiplexer. This includes a second altimeter and the addition of live HD video and real-time upload of 12-megapixel DSLR stills.

An example of the sort of analysis enabled by TEMA with the SeaView multiplexer is detailed mapping of submerged metal features for identifying

unexploded ordnance. Because of the detailed sensor data from TEMA, a post-survey analysis can identify and predict the nature of individual features in the map area of the survey with great precision.

Upgrade Path for Legacy Systems

In addition to providing enhanced capabilities for custom designs such as the TEMA vehicle, the SeaView multiplexer is designed as a pin-compatible upgrade to the multiplexers already deployed in a number of legacy systems. This enables an easy upgrade path for hundreds of legacy ROVs that were built in a less-data-intensive era. The enhanced data capabilities provided by the SeaView stack offer the flexibility to manage a wide range of sensors and the bandwidth to future-proof many existing ROV platforms.

The multiplexer's cards are designed to the PC-104 standard used in numerous existing ROV designs. This makes it easy to swap out the existing card for the pin-compatible upgrade and breathe new life into legacy equipment. Instead of acquiring a whole new ROV platform to support HD video or other applications, the SeaView multiplexer can be swapped into an existing system and add the necessary data capability for HD video and a host of other sensors.

Tech Specs Enhance Flexibility

The SeaView Systems SVS-509 OmniData Multiplexer consists of a suite of three optical video and data transmission cards, each available separately and built to the standard PC-104 form factor with a flexible set of ports: the



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SVS-109 video and data multiplexer, which provides support for three channels of standard-definition video; 10/100 Ethernet (two-port onboard switch); two RS-485 channels; four RS-232 channels; two RS-485/RS-232 configurable channels; and two high-speed triggers for sonar and USBL timing.

The SVS-209 gigabit-Ethernet-to-fiber converter provides auto-sensing capability and can support 1,000 megabits per second (mbps), 100 mbps and 10 mbps Ethernet data rates.

The SVS-309 HD-SDI-to-fiber converter provides two channels of high-definition serial digital interface (3G-SDI), as well as a nominal data rate of 2.970-gigabitsper-second video data transmission supporting up to 1080p resolution with zero compression in a range of frequencies via coarse wavelength division multiplexing (CWDM).

A World of Possibilities

An ROV or tow sled is essentially a taxi taking sensors and tools to the worksite. If you're going to the expense to put a vehicle into the water, you want to capture as much data of the best quality you can. By making this process less expensive than the previous-generation multiplexer, SeaView has made it a win-win, where you get more bandwidth, more flexibility and more options for less expense, without needing additional space. The number of different applications for the transmission of subsea data is growing every day. With the enhanced capabilities of SeaView's multiplexer stack, both custom and legacy ROVs will be ready for the requirements of the next job, or the next new set of sensors. **SI**

Matthew Cook founded SeaView Systems to focus on design, specialty products and services related to submersible ROVs. SeaView has since developed a range of products, many of which were the direct result of specialized requirements encountered during custom ROV projects undertaken by SeaView. For more information, visit: seaviewsystems.com.



As principal marine geophysicist at Tetra Tech, Richard Funk designs and develops vehicles for high-resolution integrated geophysical programs to investigate geotechnical, geological and cultural resource features, as well as UXO. His expertise includes applying magnetometry, electromagnetic induction, side scan sonar, seismic refraction and reflection (sub-bottom profiling) to these studies. For more information, visit: tetratech.com.



