MARINE TECHNOLOGY REPORTER
July 2015

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Hydrographic edition

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Introducing Teledyne Marine Multibeam Echosounder and Sonar Solutions

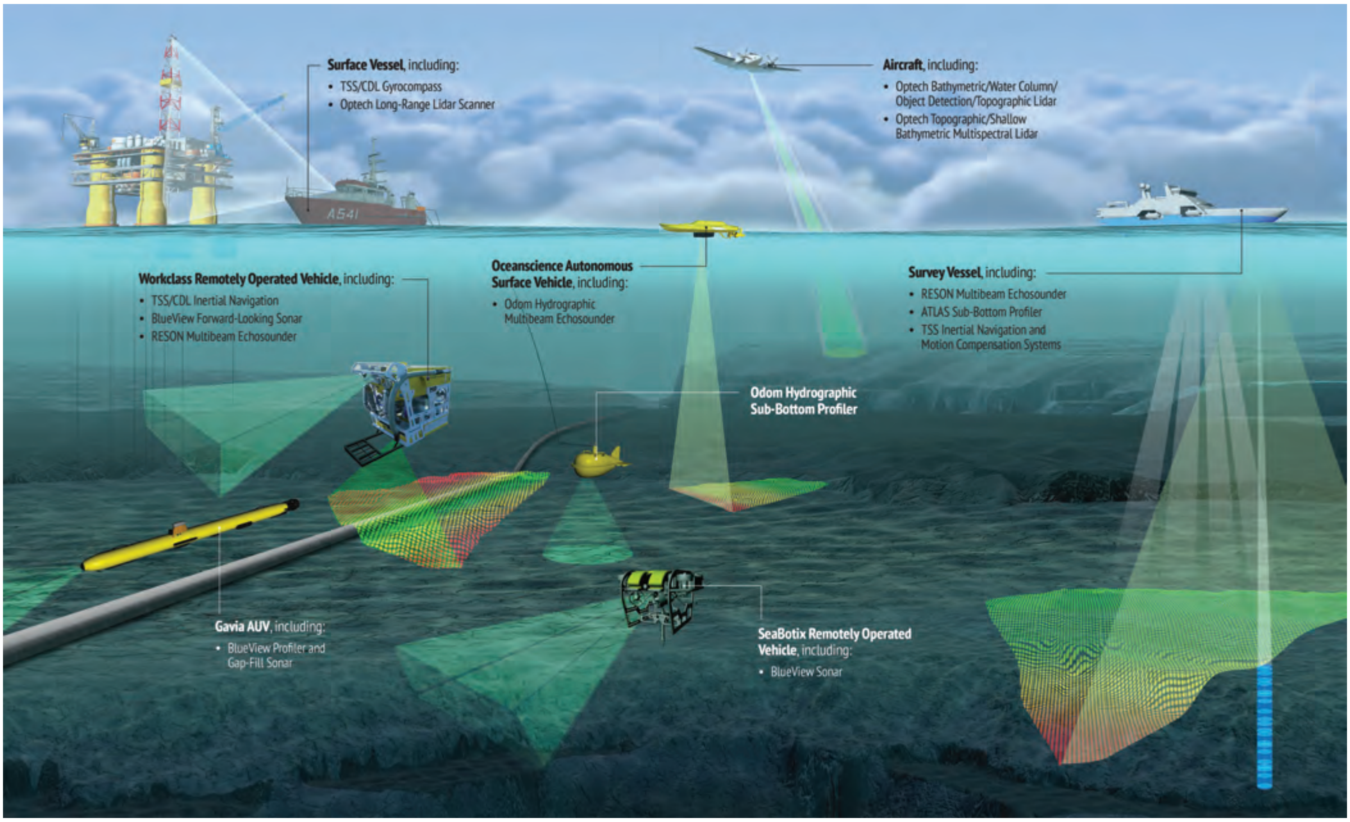


Figure 1: Teledyne Marine multibeam echosounder, sonar and lidar solutions

Introduction

Teledyne Marine is a leading provider of advanced multibeam echosounder and sonar solutions servicing a variety of markets and applications. By delivering the most advanced acoustic technology solutions Teledyne Marine provides high resolution, accurate, dependable, long lasting solutions to our customers. Singlebeam echosounders and entry level multibeam bathymetric systems are manufactured by Teledyne Odom Hydrographic, high resolution multibeam echosounder systems and long range forward looking sonar are manufactured by Teledyne RESON, high-end deep water multibeam systems like the HYDROSWEEP from Teledyne ATLAS Hydrographic and 2D forward looking sonar as well as 3D multibeam scanning sonar aremanufactured by Teledyne BlueView.

The combined strength of the four brands, also known as the Teledyne Marine Acoustic Imaging Group, delivers the strongest collective porfolio in the market for subsea acoustic imaging and multibeam echosounder solutions.

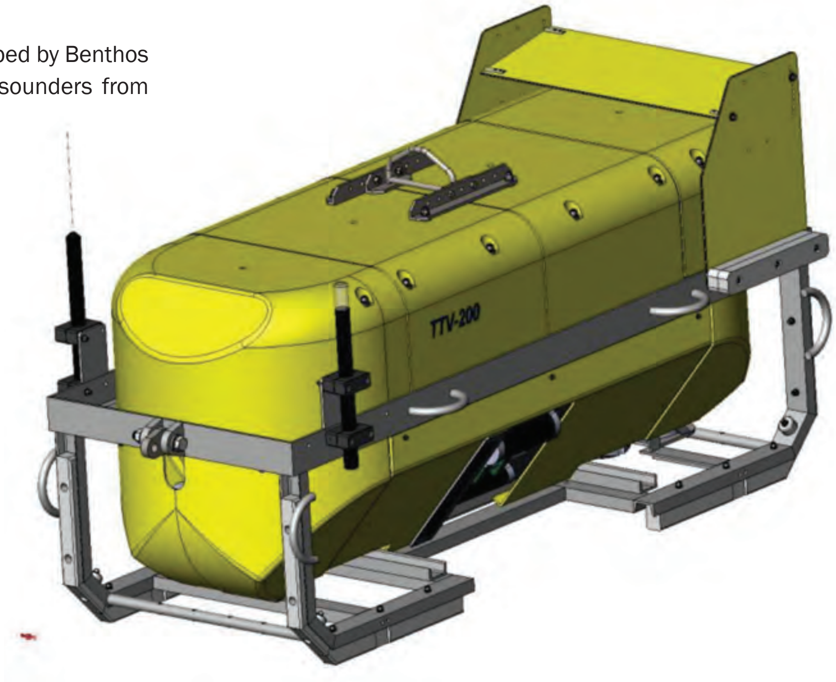
Oceanscience, Optech, CDL and TSS are also part of Teledyne Marine supplying sonar solutions. Teledyne Oceanscience develops the autonomous remote operated Z-Boat survey boat, which in partnership with Teledyne Odom Hydrographic is equipped with single and multibeam echosounders.

Teledyne Optech develops and manufactures advanced lidar and camera survey instruments for airborne, mobile and terrestrial mapping.

Teledyne CDL and Teledyne TSS design and manufacture a variety of sensors including gyrocompasses, attitude and heading reference systems, and inertial navigation systems.

Teledyne Marine has locations focused on multibeam echosounder and sonar technology including manufacturing, research & development, sales and after sales support at the sites in Denmark as well as in Holland, Germany, U.K and

Figure 2: The deep tow vehicle is co-developed by Benthos and RESON and includes multibeam echosounders from RESON and a doppler velocity log from RDI.



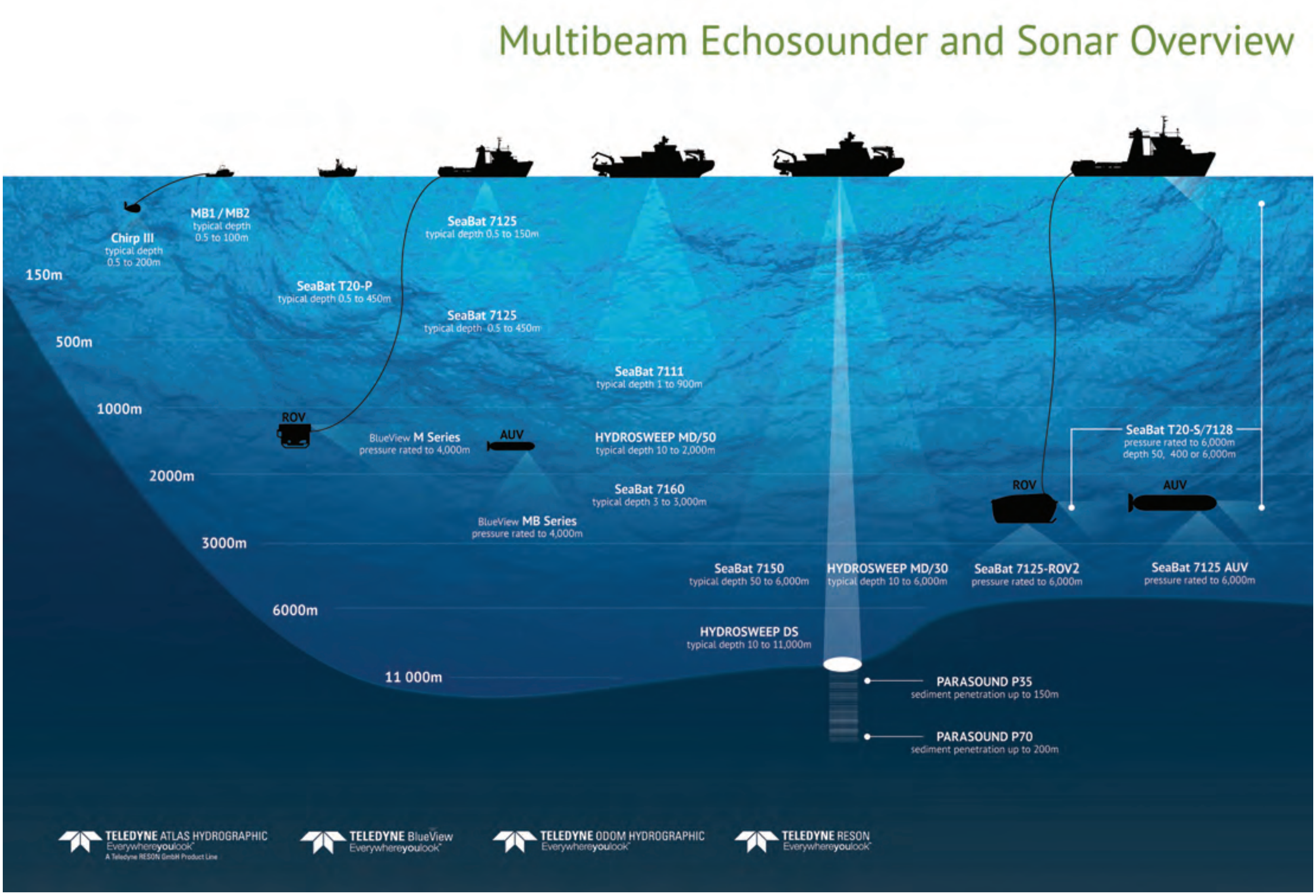


Figure 3: Teledyne Marine multibeam echsounder and sonar range overview

the USA and Shanghai. Furthermore it supportscustomers through a truly global sales network of distribution partners in more than 47 countries.

The Teledyne Marine Acoustic Imaging Group counts more than 40 engineers and hydrographic surveyors dedicated to its Engineering Services team focused on providing close support to our multibeam echosounder and sonar customers, wherever they are and whatever the circumstances. The Engineering Services team operates out of service centers at six locations worldwide and it has extended theproximity to customers through a global network of service partners.

The Teledyne Marine companies are deeply integrated and work closely together to develop cutting edge solutions, such as Teledyne Benthos and Teledyne RESON collaborating to develop a deep tow system for Odessey Marine Exploration. The deep tow vehicle, which includes a SeaBat 7125 Dual Head multibeam echosounder, is currently undergoing final sea trials and will, amongst other missions, primarily be used for search missions in very deep water down to 6000 meters. **(see figure 2)**

Teledyne Marine offers multibeam echosounder and sonar solutions in a variety of application areas including offshore, hydrography, civil engineering and dredging as well as defense & security.

Hydrography

Within Hydrography Teledyne Marineprovides a combined product portfolio to cover a full range of survey tasks at hand. It provides the sonar solutions for seabed mapping from extremely deep water to shallow water to map cable and pipeline routes, navigation channels and whether you need a multibeam echosounder or a full turnkey hydrographic solution,Teledyne Marine is able to match your requirements for size, ease of use and performance with a quality package that matches your budget. The Teledyne Marine systems have you covered at nearly any depth, from HYDROSWEEP DS multibeam echosounder and PARASOUND sub-bottom profiler on the largest ocean going vessels in the deepest oceans, to the SeaBat 7125 for high resolution surveys for inland or coastal areas. The systems are also available for use on ROVs and AUVs for use down to 6,000m depth. **(see figure 3)**

Teledyne Marine offers all accessories to deliver a complete solution rangingfrom sound velocity sensors, brackets, mounting kits, gondolas, and cables to motion compensation and INS systems including processing station, installation and final hand-over to qualify and secure the final system performs optimally.

Teledyne PDS's software solutions provide turnkey packages for Teledyne Marine's singlebeam echosounders, multibeam bathymetric sonars, and multibeam scanning sonars. All sonar solutions provided by Teledyne Marine output industry standard data to interface with all major hydrographic sonar data collection packages.

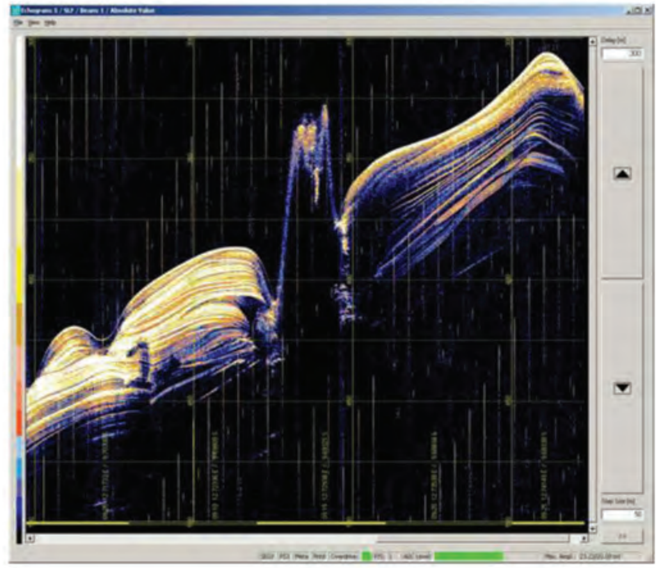


Figure 4: More than 50m penetration along a slope at approx. 400m water depth. Courtesy of University of Bremen, recorded onboard research vessel Meteor

The Teledyne Marine hydrographic application areas are typically seafloor mapping, route surveys, ports & and harbors and marine research.

Offshore

Offshore is a primary focus area for Teledyne Marine. Teledyne RESON and BlueView offer a comprehensive product program for dedicated multibeam echosounders and sonars, supported by a global service organization to follow and support customers in this international industry. The forward looking imaging sonars from Teledyne BlueView provide an invaluable aid to ROV operators when navigating and maneuvering around Offshore subsea structures, and for pipeline surveying the SeaBat 7125 system is the favored choice for many survey companies, providing unrivalled performance. On the forefront of technology are innovative market leading features such as target detection systems for station keeping of ROV's and automatic tracking systems to detect and follow pipelines. This is technology that provides customer value by improving operational effectiveness, reducing cost and shortening the time from data collection to end-product. Main applications within offshore are pipeline surveying, metrology, inspection & monitoring, obstacle avoidance and leakage detection.

While the wide range of multibeam echosounders gather high resolution terrain information from the seafloor, Teledyne's sub-bottom profilers look deeper. With PARASOUND, sediment structures as slim as 15 cm can be visualized, buried objects can be localized prior offshore cable trenching, or geologically stable pipeline routes identified. **(see figure 4)**

Figure 5: Dredge application – Digital Terrain Model

Figure 6: BlueView construction monitoring data image

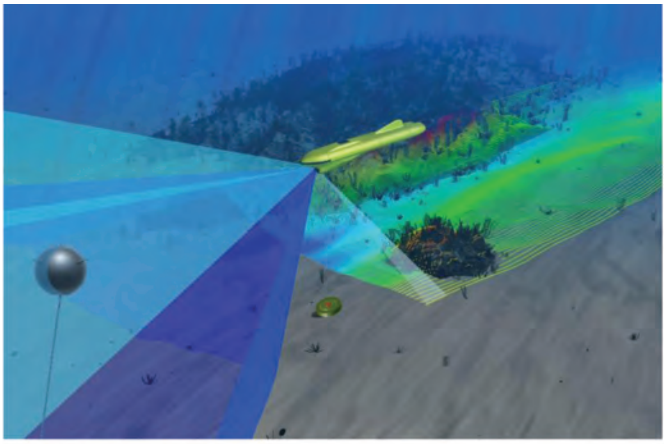


Figure 7: BlueView forward looking sonar, micro-bathymetry and gapfil sonar on AUV

Civil Engineering & Dredge

Teledyne Marine offers a comprehensive suite of solutions to support Civil Engineering & Dredge operations. Our product range includes hydrographic grade singlebeam echosounders, sub-bottom profiles and sound velocity profilers by Odom Hydrographic, 2D imaging sonars and 3D multibeam scanning sonars by BlueView and the SeaBat world leading range of multibeam echosounders all coupled with the power of Teledyne PDS software for hydrographic surveying and dredge guidance operations.

With decades of experience Teledyne Marine knows that robust, easy to use equipment and accurate results are crucial to the success of its customers. Teledyne Marine is the only supplier with a full spread of acoustic and software solutions to meet the demands of the civil engineering and dredge market.

Main application areas are during, pre and post dredge surveys, dredge guidance, construction support, bridge dam & harbor inspection and scour and undercut monitoring.

Accuracy is crucial for pre and post dredge surveys. Every centimeter counts as removal of even a fraction of a meter in depth can be a costly undertaking when done over a large area. **(see figure 5)** Teledyne Odom provides accurate soundings with a unique patented bottom detection process for the most reliable results. Sounders are frequency agile and provide either paper or electronic readout. For a highly portable and robust multibeam echosounder,consider the Odom MB1 or MB2. For higher accuracy in a portable water resistance package take a look at the SeaBat T20-P. For those demanding nothing but the best look to the SeaBat 7125 for uncompromising accuracy and a powerful set of features.

High resolution multibeams provide a unique ability to monitor and support subsea construction by allowing engineers to

Figure 8: SeaBotix LBV200 with BlueView P900-130 imaging sonar

visualize progress in real time. BlueView 2D imaging sonar provide high resolution real time imaging and 3D multibeam scanning sonar provide high resolution 3D point clouds of areas and structures scanned for inspections throughout the construction project. **(see figure 6)** RESON SeaBat multibeams support operations requiring longer range and where the most stringent hydrographic results are required, and also provide a powerful set of features.

Defence and Security

Today more than ever, nations rely on their naval capabilities to maintain their national interests at home and abroad. The demand for ever enhancing capabilities combined with tighter budgets is an ongoing challenge for most navies. Teledyne Marine is ready to support those needs by leveraging the widest range of sonar systems and hydrophones on the market, and offers the ability to customize capabilities when required.

Commercial-off-the-shelf (COTS) products provide excellent performance for a fraction of the price of traditional military systems, the cost of ownership through the product lifecycle is typically lower for commercial systems. Teledyne Marine is represented in the naval market by products from RESON and BlueView including multibeam echosounders for tactical bathymetric mapping, 2D forward looking sonars for a variety of applications, and high quality hydrophones widely used by navies and institutes around the world.

Main application areas include terrain mapping, obstacle avoidance, mine counter measures, diver detection and first responder support.

Obstacles in the water column range from debris to moored mines and are a risk to survey assets and the personnel that operate them. Traditional surface vessels rely on charts for safe of navigation, but for naval operations charts are often unavail¬able. Underwater vehicles must avoid objects in their path and are often fitted with single beam scanning sonars for this purpose, however, these provide a slow update rate only covering part of the forward sector at any given instant. Teledyne Marine has the answer, from larger long range SeaBat systems which can operate on surface vessels to 6,000m depth, to the most compact low power BlueView 2D sonars (depth rated to 3,000m) Teledyne Marine has a solution that will work for you. **(see figure 7)**

The ability to locate and stabilize a drowning victim quickly can be the difference between life and death. Teledyne Marine has a variety of solutions to support first responders allowing them to improve the speed of victim recovery. Solutions include 2D multibeam imaging sonars such as the RESON SeaBat 7128 most suitable for surface vessel mount; to the more compact, lower weight BlueView multibeam sonars, suitable for surface vessel use, but also for use on portable low logistics ROVs or diver handle hand units – a powerful tool to get the job done quickly. **(see figure 8)**

Figure 9: Teledyne PDS Software Suite, now available in a 64-bit version.

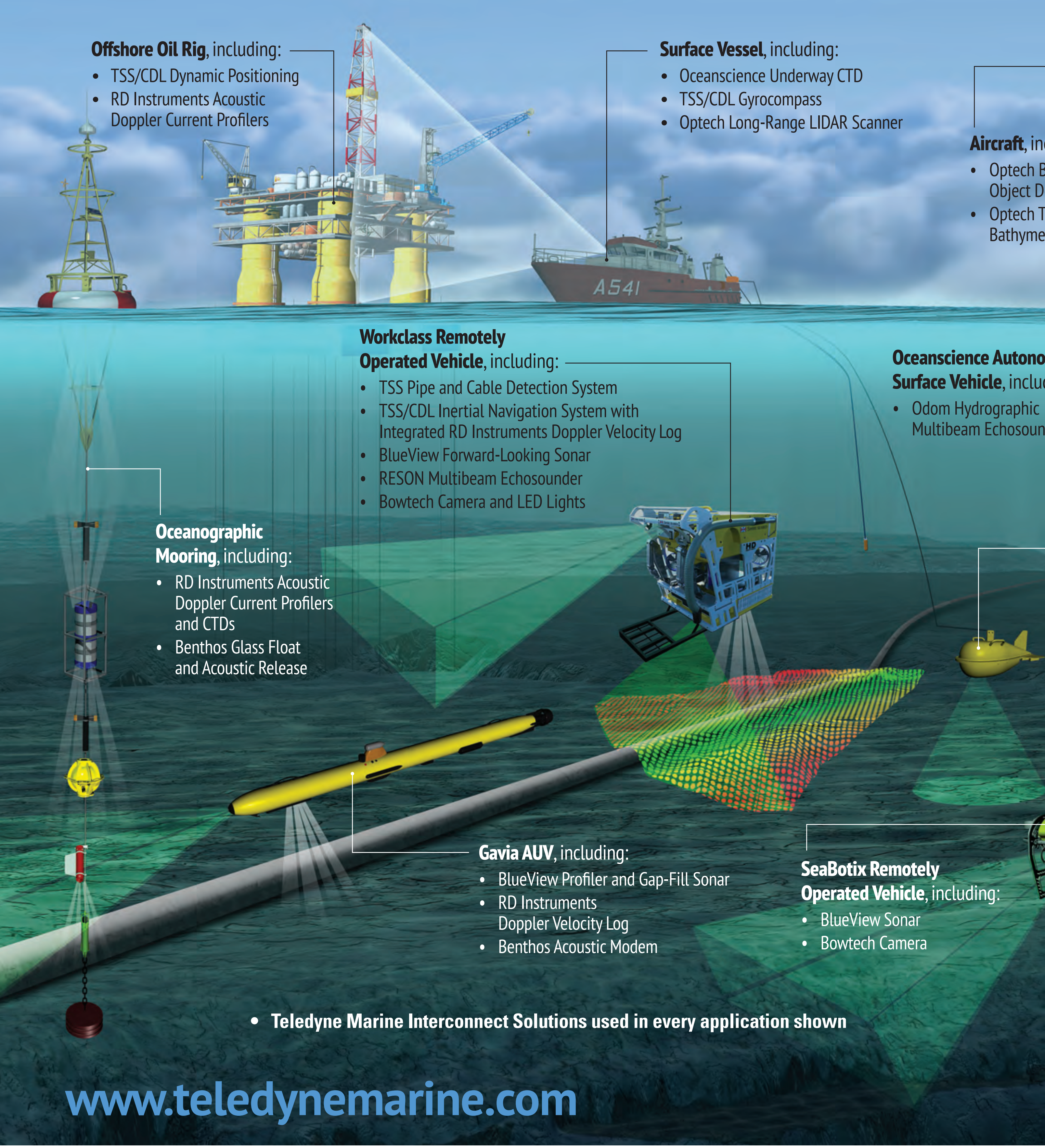
Teledyne PDS software suite

Teledyne PDS is a multipurpose software platform and supports a wide range of tasks within Hydrography, Dredge Guidance, Construction Support, Search & Recovery Operations and Port Entrance Monitoring.

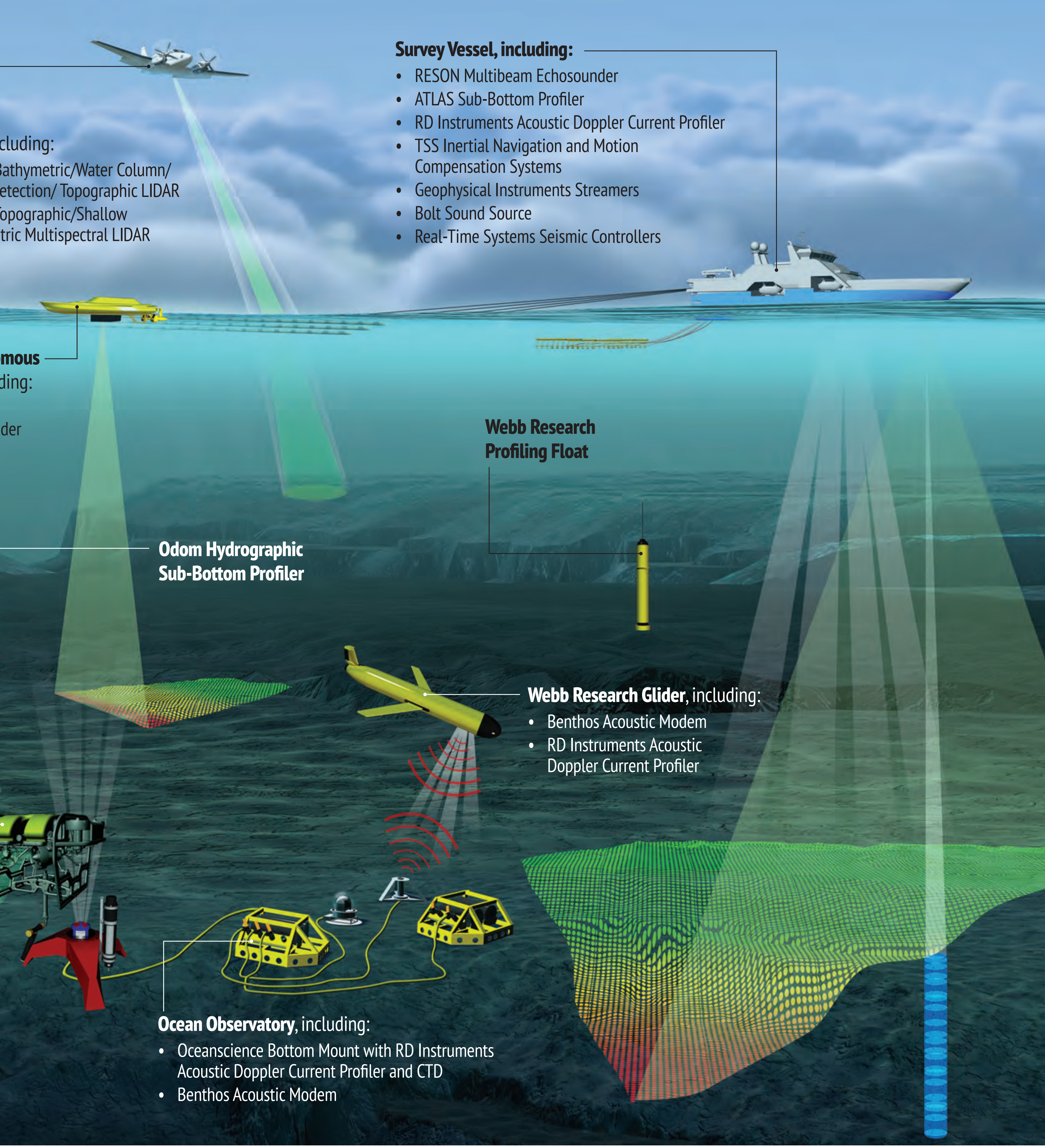
Teledyne PDS is of-the-shelf software and developed to solve the variety of challenges that arise from each specific task in the main application areas served by Teledyne Marine. It interfaces with a wide range of survey instruments such as lidar, multibeam and singlebeam echosounders, and is an optimal tool for interfacing to a variety of periphery sensors, including dredge and construction sensors, sound velocity measurements, positioning, motion systems and most other devices that output data. **(see figure 9)**

Teledyne PDS is an optimized solution for both Teledyne Marine products and almost all other available systems in the market from recognized manufacturers, and enables immediate data visualization and quality control, so you can view results as images or numerically in real time. The software is designed to be used in the maritime world with an intuitive user interface that is easy to learn. Support is provided worldwide by Teledyne Marine expert surveyors including survey assistance and training of operators.

For further information, contact Teledyne Marine at:
www.teledynemarine.com



A Sea of Solutions



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Port of Rotterdam

How to produce bathymetric products within one day after surveying.

Situation

The Port of Rotterdam is an open deep-water port in theriver estuary Maas. The location of the port in an estuarineenvironment necessitates maintenance dredging due tosiltation 'attacks' from both tidal current and riverdischarge. Siltation from the sea, coming in during theflood tide and eroded materials from the hinterlandtransported in the river flow results in a total of 6.000.000m3 of maintenance dredging works in the port basinsevery year.

To control the dredging activities the Port of Rotterdamconducts hydrographic surveys on a daily basis. Two

purpose built survey vessels are operated by the AssetManagement department of Port of Rotterdam.

The survey vessels are equipped with Teledyne RESONSeaBat multibeam echosounders (model 7101 and 7125),RTK GNSS positioning and silt density equipment (Silas-Odom CV2).

Challenge

Continuous multibeam surveys result in large datavolumes and processing time. The goal of the Asset

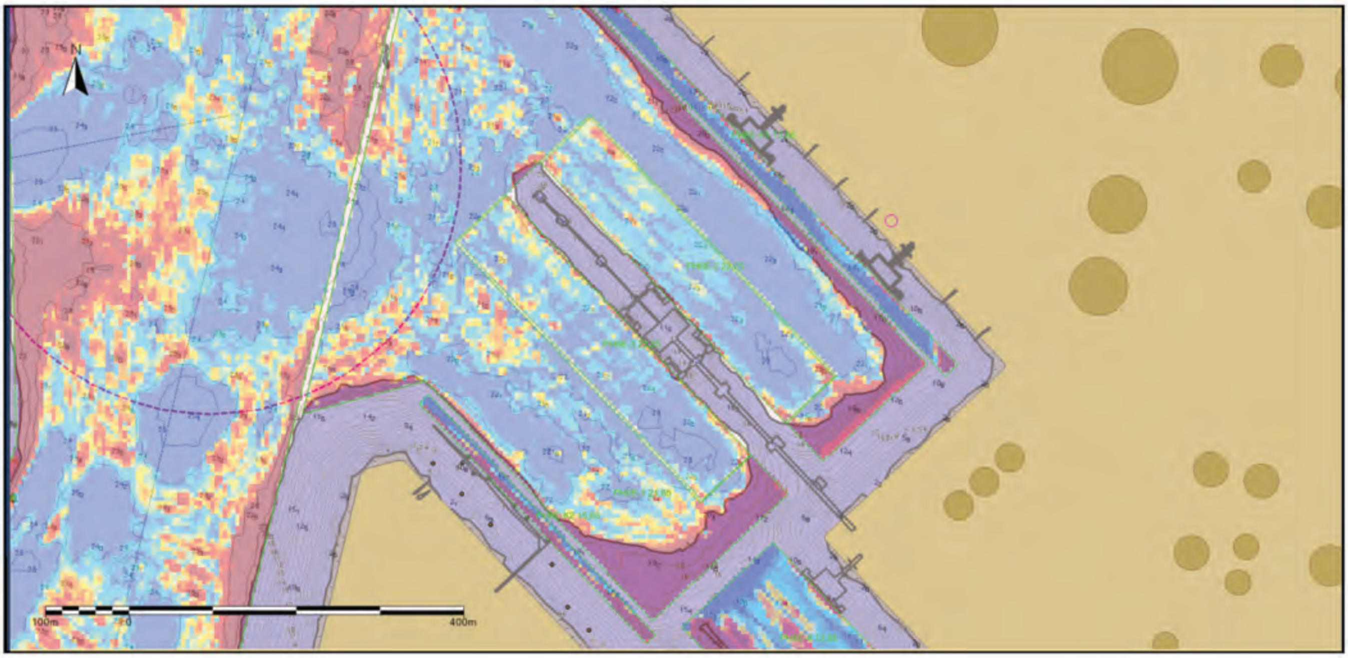
Management Department is to produce bathymetricproducts within one day after surveying. Products are:

- ***Bathymetric paper chart for vessel traffic management (VTM) and dredging operations***
- ***Electronic Navigation Chart (ENC) for portable pilotunits (PPU)***
- ***ASCII gridded data sets for dredging equipment andGIS analysis***

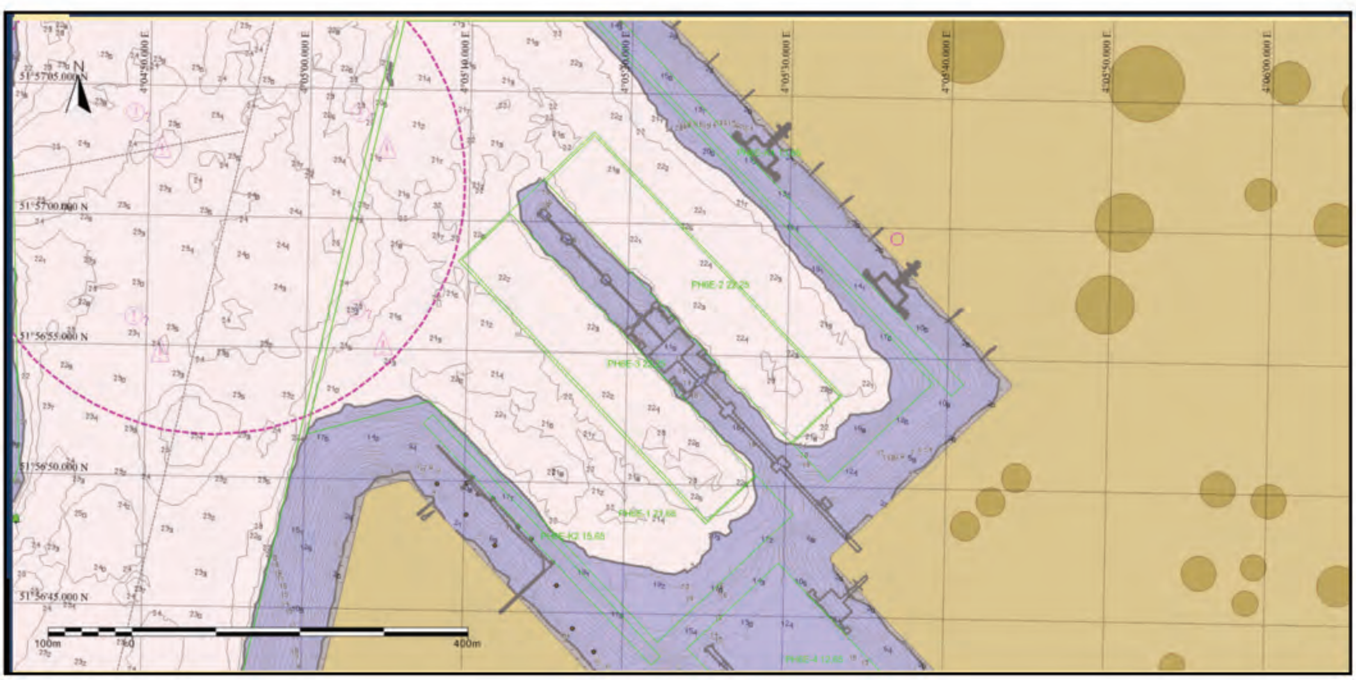
Shipping, berth occupancy, satellite blocking by cranes orcontainer stock piles, sea water mixtures and fluid mudbottoms are a continuous threats to the quality andproduction rate of the bathymetric surveys. To save processing time the Asset Management Department try tokeep up the 'first time yield' level. This process starts withhigh quality raw multibeam data input. Cleaning datafilters will run faster and more accurate based on almostclean raw data obtained from the best available surveyequipment

Survey operations

Typical port hydrographic surveys contains locations withslopes, various bottom types and man-made constructionsin a relatively small area requiring the use of an all-roundmulti-



Dredging information based on difference of latest multibeam surveys and maintenance levels



Weekly ENC production based on latest multibeam surveys beam echosounder system that provides:

- ***Wide beam coverage to get depth data as close as possible to water level on slopes***
- ***Single transducer head (complexity and datareduction)***
- ***Excellent object detection***
- ***Variable pulse length settings to optimize acoustics for fluid mud bottoms***
- ***High update rate for survey speed up to 10 knots***
- ***Side scan option***

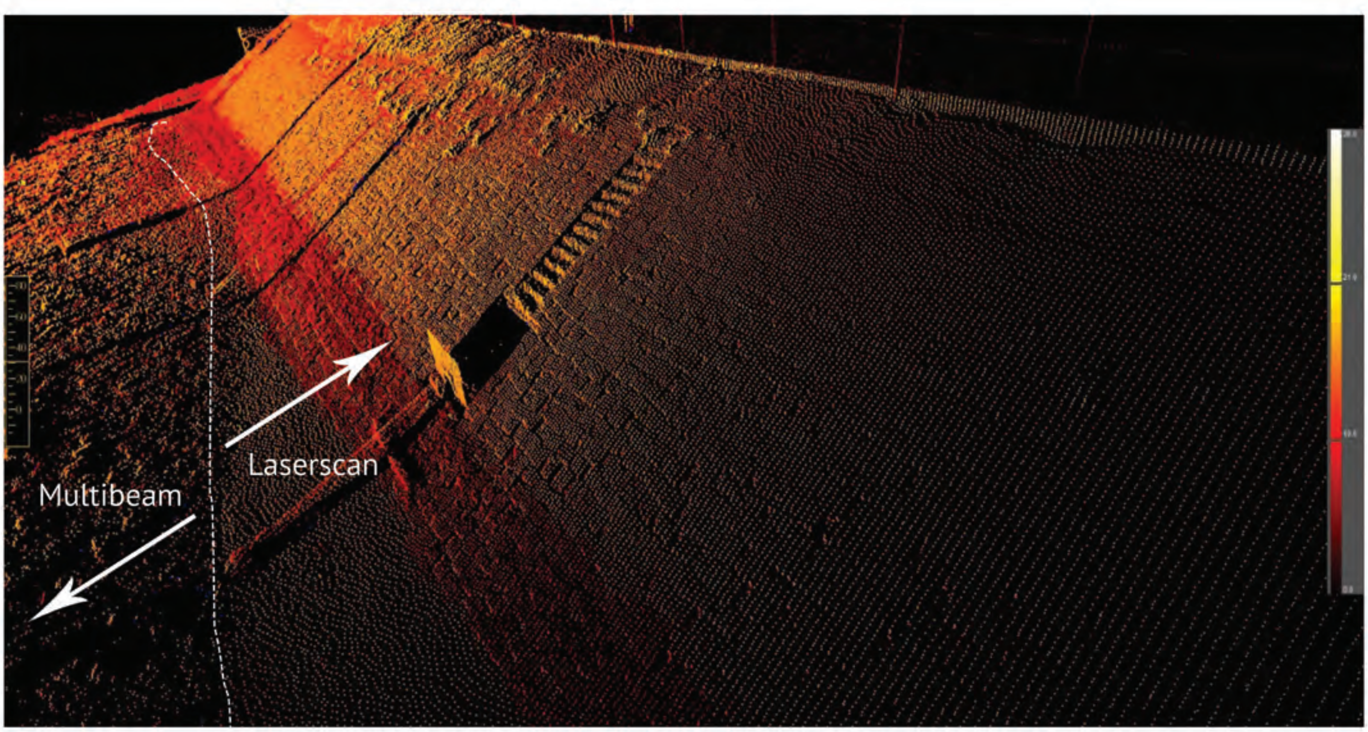
The Seabat 7101 and 7125 meets all the requirementsmen-tioned above. The data quality is very good hence hardly any data cleaning is necessary post survey. Thebeam selection settings (to set area of interest) and systemdisplays are features that make these systems particularlyuser friendly.

SeaBat 7125 SV2

Results

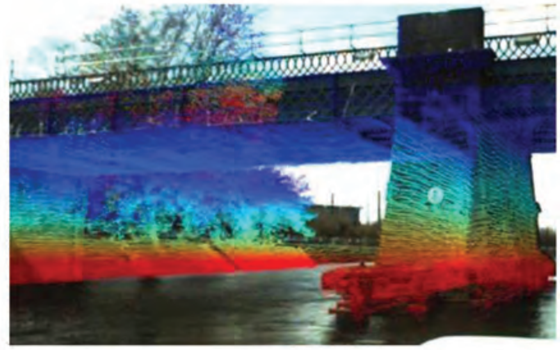
Since the end of 2012 the Asset Management departmentof the Port of Rotterdam developed a range of efficiencyefforts to reduce the need for survey personnel andequipment. These efforts resulted in a reduction of abouthalf a survey vessel, representing a cost saving ofapproximately €150,000 per year; in part due to theupgrade of the muliteam systems to the Teledyne RESONproducts mentioned above.

Combined 7K Multibeam – Laserscan data

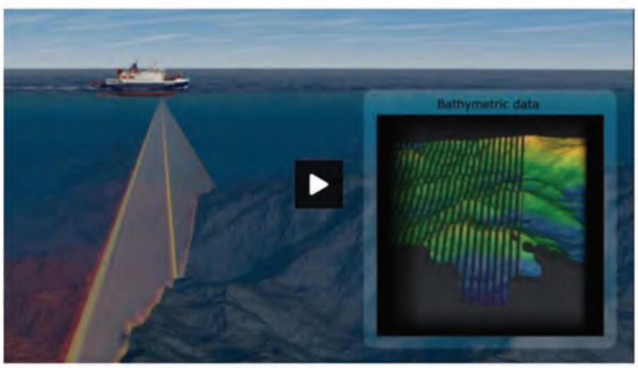


Teledyne Marine Case Stories

http://www.teledyne-reson.com/case-stories/



http://www.blueview.com/news/



http://www.teledyne-atlashydro.com/news/case-stories/

http://odomhydrographic.com/news/case-stories/

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Implementation of a Multibeam Echosounder and Terrestrial LiDAR in Support of a Dam Spillway Construction Project

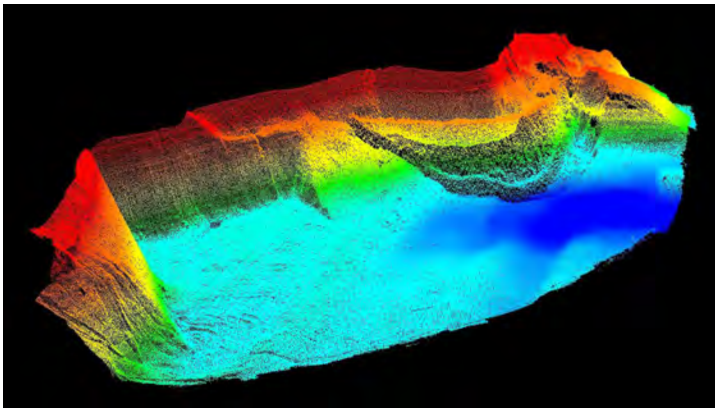
By: Tom Cade, R.E.Y. Engineers, Inc. and Cody Carlson, Seafloor Systems, Inc.

Nestled Northeast of the city of Folsom, California, sits the 11,450-acre Folsom Lake—formed by an existing dam on the North Fork and South Fork of the American River. It is responsible for providing irrigation, drinking water, and electricity to parts of California, as well as flood prevention for the areas situated south of the lake. Despite the low risk of a damaging occurrence, it was decided (under the Reclamation Safety of Dams Act) that preventive measures needed to be taken to protect those living downstream. Construction of a new auxiliary spillway is in progress, which will provide a means for a steady water outflow during an increased water flow event. Carried out in phases, this project requires surveys from land and water to ensure successful completion. The $900-million cooperative project between the U.S. Army Corps of Engineers, U.S. Department of the Interior, and Bureau of Reclamation will assist the Sacramento region to achieve the 200-year level of flood protection.Completion of the auxiliary spillway is scheduled for late 2017.

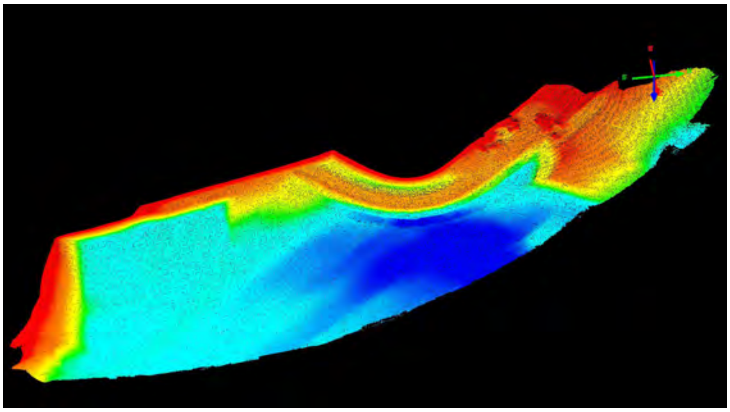
To support the project, R.E.Y. Engineers, Inc. (Folsom, California) has conducted bathymetric surveys and back scatter imaging. Seafloor Systems (El Dorado Hills, California) provided the equipment and on-site operational expertise for the hydrographic survey. Specifically, R.E.Y. Engineers, Inc. was tasked to provide bathymetry and ground control for the new spillway

Downstream Face – Existing Spillway

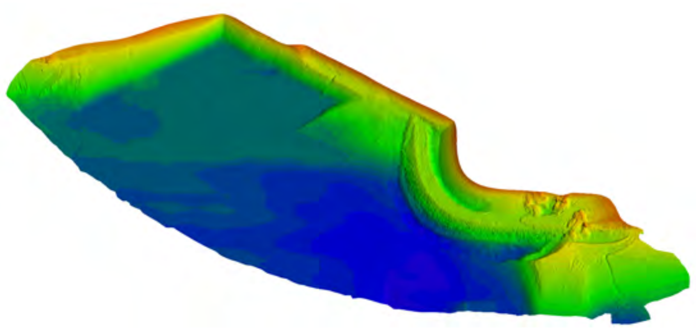
Aerial View – Existing Spillway on left. Auxiliary Spillway and Spillway Chute under construction to the right (©Google Earth)

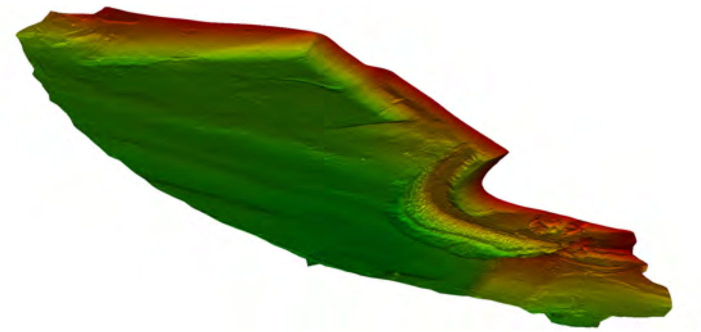


Approach Channel Acceptance Survey – Multibeam point cloud of upstream approach channel & spur dike, perspective view



Approach Channel Acceptance Survey – Multibeam point cloud of upstream approach channel & spur dike, plan view


Approach Channel Acceptance Survey – Multibeam TIN model of upstream approach channel & spur dike, perspective view


Approach Channel Acceptance Survey – Multibeam TIN model of upstream approach channel & spur dike, perspective view

construction.The hydrographic equipment supplied and operated by Seafloor remained the same throughout the project; however, three vessels were used, each with unique challenges to overcome:

- The first vessel was a 24-foot Fisher pontoon boat, equipped withan Applied Marine System Hydro-Mount—which made sonar installation and vessel launching seamless with its mounting diversity and rotating arm. The stable platform of the pontoon and spacious work area seemed made for a very pleasant day.
- The second vessel was a 14-foot Valco. Due to the limited space, an existing sonar mount was modified and strengthened to accommodate the heavier multibeam.Althoughit was challenging to work in such a small area with the various equipment topsides, the main issue was vessel vibration. At a certain engine RPM, the aluminum boat shook with the force of a small tremor and introduced noise into the bathymetry data; this made for a very slow moving and long day.
- The third vessel was a 21-foot Bennington pontoon, custom outfitted specifically forhydrographic surveying. Moving back to the Applied Marine Hydro-Mount, it features a dedicated workstation, stable antenna frame, mobile LiDAR mount, and even a head…truly the Cadillac of the project so far.


Survey Vessel – 24' Fisher pontoon configured for multibeam & mobile LiDAR acquisition


Approach Channel Acceptance Survey – Survey vessel acquiring multibeam sonar data


Approach Channel Acceptance Survey – Survey vessel acquiring multibeam sonar data

The ability to mobilize quickly without sacrificing data integrity (due to +/- 0.5 foot accuracy specification) was crucial for the completion of these on-going surveys. With this in mind, the survey platform consisted of the following:

- **Applanix POS-MV™Wavemaster Inertial Navigation System**

http://www.seafloorsystems.com/posmvwavemaster.html
Used to provide roll stabilization to the multibeam in addition to positioning, heading, roll, pitch and heave of the vessel's reference point. Due to the steep slope of the spillway embankment, the POS-MV was chosen in case of radio shadow or GPS dropout.

- **Reson SeaBat® T20-P Multibeam Sonar**

http://www.seafloorsystems.com/multi_echosounder.html
Gathered both bathymetry and backscatter imagery, operating at its full 512-beam capacity, with a reduced ping-rate of 20Hz to keep data processing time down without creating holes in the final surface. The T20-P was ideal for this project due to its small size, ability to be rotated, and high-resolution capability.

- **ValeportMiniSVS**

http://www.seafloorsystems.com/ctd.html
The ValeportMiniSVS was mounted on the pole, next to the sonar head, allowing it to provide surface speed of sound measurements used in the multibeam's beam forming.

- **Odom DigiBarS**

http://www.seafloorsystems.com/ctd.html
The Odom DigiBarS acquired sound velocity profiles at a 1-meter increment throughout the water column.

- **Trimble R7 GNSS receiver set as a RTK base station**

http://www.seafloorsystems.com/satellite.html
Finally, a Trimble R7 GNSS base receiver occupied a control point at the edge of the spillway embankment. It made use of a Trimble TDL-450H UHF radio to send CMR+ corrections to the POS-MV, and a 0dB gain omnidirectional antenna, radiating in a spherical pattern better suited to overcome the vertical relief between the top of the embankment and the survey area below.

Sacramento River—Riegl VMX-250 & CS6 Mobile LiDAR System

Once the equipment was installed, configured, and offsets measured with a total station, it was time to begin the survey. The control for the survey had already been established, based upon the primary control point for the damspillway construction project. An auxiliary control point was set at the edge of the spillway embankment, providing unobstructed line-of-sight to the bathymetric survey area below. The horizontal position for this point was established via two three-minute RTK observations from the dam spillway. The elevation of this point was established via digital barcode leveling, also from dam spillway.While on the water, the Reson Seabat Multibeam was busy calculating 10240 points per second—deciding whether each point passed both the brightness and collinearity tests—the Applanix provided data at 100Hz, logging the raw trajectory information for use in post-processing while the Trimble was on the bank logging GPS (L1, L2, L5) and GLONASS (L1, L2) internally at one second, to be used in the post-processing of the trajectory from the Applanix. (It is important to note that in order to successfully post-process the GNSS data, a sufficient duration of satellite data must be acquired to enable initialization of the solution. In general, the duration of data required is directly dependent upon the distance to the base station—in this case, the distance was less than 2km. Data logging on the POS-MV was initiated 5 minutes prior to the start of sonar acquisition, and continued for an additional 5 minutes after completion. A general rule of thumb is 30 minutes of data for every 20km of distance.)The small area was contained within a silt screen, and the quick rise of the lake bottom, coupled with large boulders made for a few nail-biting moments, but luckily, no damage was done to the sonar head. Finding a suitable patch test area was a challenge for the surveys, due to the restrictiveness of the silt screen and its habit to move around between surveys. In the end, each one of the surveys provided 400% bottom coverage and acceptable patch tests.

With the field work completed, processing the data began. First, the raw data from the base station and the POS-MV was post-processed in POSPac MMS version 7.1 SP1, producing a smoothed best estimate trajectory (SBET). During processing, the survey was processed forward in time, then backward in time, and then combined to produce the final trajectory. The final tightlycoupled trajectory was the result of a blended solution, incorporating all observables (GNSS and attitude), such that the trajectory maintains the positional accuracy of the GNSS data while incorporating the dynamic accuracy of the IMU and heading information. The resulting SBET file was then imported in to HYPACK 2014 for post-processing of the sonar data.Within HYSWEEP's 64bit editor, the SBET file was applied, along with the sound velocity profiles, first to the patch test lines, and then to the survey area, once the patch test values were found.

The data was cleaned using a combination of methods. Only one base filter was applied to the bathymetry, which flagged any point that did not pass the Reson QC tests. After checking the impact on the data, those points were removed. Next, erroneous points (multipath & specular reflection) were removed in HYPACK's Sweep Editor. The Sweep Editor will show a user-defined amount of pings (400 sweeps was used, which is 20 seconds of data), which allows trends in the data set to be observed. To keep the final project manageable, the data was reduced to a 1-foot grid, and the median value for all points within a cell was chosen. After viewing the gridded color model within HYSWEEP, areas of question were opened in HYSWEEP's Cell Editor. The cell editor shows all points within a single cell, and gives an option to view the points in surrounding cells as well. With repeatability (accuracy) in mind, the overlapping data from separate lines in the questionable cells was examined, and points that strayed considerably from the repeatable bottom were removed.

The 1-foot XYZ, which used actual XY data where possible, was exported from HYPACK and brought intoAutoCAD® Civil 3D® 2013 to create the digital terrain model (DTM). The bathymetry was then compared to a terrestrial LiDAR scan that was also performed by R.E.Y.Engineers. Prior to the first hydrographic survey, due to the ongoing drought in California, the water level of Folsom Lake dropped enough for construction vehicles to work in the (now underwater) survey area, which in turn, warranted a terrestrial LiDAR scan to be conducted.

Shortly before the first survey, a moderate amount of rainfall occurred, bringing the lake water level to a point where hydrographic survey was possible, and needed. In the comparison of the two data sets, it was revealed that, roughly, only 30% of the allowable error budget was used.

Thanks to the different types of hydrographic survey equipmentthat was used, and successful surveying that was conducted, the project was completed to the satisfaction of the client and on schedule.

Editorial Calendar

MARINE TECHNOLOGY REPORTER

ISSUE	EDITORIAL	BONUS DISTRIBUTION	AD CLOSE
January/ February	**Underwater Vehicle Annual: ROV, AUV, and UUVs** **Market:** Subsea Engineering: Oil & Gas **Tech:** Harsh Environment Systems for Arctic Ops **Product:** Scientific Deck Machinery	**Arctic Technology Conference** March 23-25, Copenhagen, Denmark **Subsea Tieback** March 3-5, New Orleans, LA	January 21
March	**Oceanographic Instrumentation: Measurement, Process & Analysis** **Market:** U.S. Navy Strategic Initiatives **Tech:** Ocean Business 2015 Technology Spotlight **Product:** Sonar Systems & Seafloor Mapping	**Ocean Business** April 14-16, Southampton, UK **Sea-Air-Space** April 13 - 15 National Harbor, MD	February 18
April	**Offshore Energy Annual** **Market:** Seismic Vessels & Systems **Tech:** Deepwater Positioning, Mooring & Anchoring **Product:** Subsea Vehicles and Systems for Pipeline Survey & Inspection	**Offshore Technology Conference** May 4-7, Houston, TX **AUVSI 2015** May 5-7, Atlanta, GA	March 27
May	**Underwater Defense** **Market:** Offshore Renewable Energy: Wind, Wave & Tide **Tech:** International Naval Technologies **Product:** Remote Sensing & Environmental Monitoring	**MAST Asia** May 13-15, Yokohama, Japan **UDT** June 3-5, Rotterdam, NL	April 24
June	**Hydrographic Survey** **Market:** Comms, Telemetry & Data Processing **Tech:** GPS, Gyro Compasses & MEMS Motion Tracking **Product:** Interconnect: Underwater Cables and Connectors		May 27
July/ August	**MTR100** **The 10th Annual Listing of 100 Leading Subsea Companies** **Market:** Offshore Europe Tech & Trends	**Offshore Europe** September 8-11, Aberdeen, UK	July 21
September	**Ocean Observation: Gliders, Buoys & Sub-Surface Networks** **Market:** Oil Spill Monitoring & Tracking Systems **Tech:** Seafloor Engineering & Remote Operations **Product:** Geospatial Software Systems for Hydrography	**OTC Brazil** October 26-29, Rio de Janeiro, Brazil **SeaTech Week** October, Brest, France	August 21
October	**AUV Operations** **Market:** Research Vessels **Tech:** ROV Technology: Workclass to Micro Systems **Product:** Underwater Tools and Manipulators	**Oceans 2015** October 19-22, Washington DC **SNAME** November 4-6 Providence, RI	September 25
November/ December	**Subsea Engineering & Construction** **Market:** Fresh Water Monitoring & Sensors **Tech:** Offshore Inspection, Maintenance & Repair (IMR) **Product:** Underwater Imaging: Lights, Cameras & Sonars	**Underwater Intervention 2016** New Orleans	November 26

High Quality Surveys

By Jan Siesjö, SAAB Seaeye and Frans Nijsen, QPS

Introduction

The acquisition of QPS by Saab opened up for the possibility for closer integration between the Saab AUV platforms and the data acquisition software from QPS. This resulted in a joint project in 2014 to demonstrate a high end survey system that was capable of very accurate combined sonar, multibeam bathymetry, video and subbottom profiling. The system is based on Saabs hovering AUV capable of very stable autonomous close up scanning of both structures and bottom features. The QPS data acquisition software ensures that all data is collected together with navigation data in an optimal way for precision and further processing. The result is merged data of high quality that is easily evaluated and exported.

Sabertooth

The Sabertooth hybrid AUV is based on technology coming out of the Saab Double Eagle and SAROV vehicles as well as components from the commercial ROV range. The result is a vehicle that is very quiet and stable with advanced autonomy. Using commercial components manufactured in larger numbers means that costs are kept down while still retaining high reliability and high availability of spares and support.

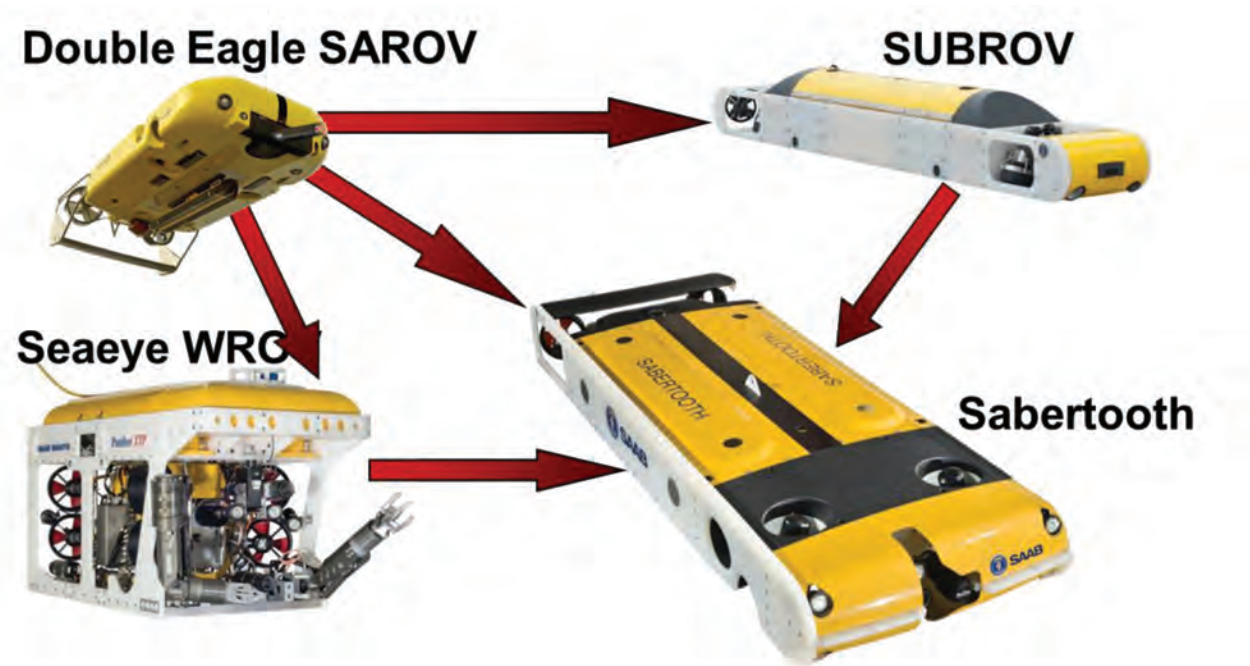
QINSy

QINSy is the real time data acquisition software package being out in the hydrographic and marine industry for more than 20 years, and is part of the hydrographic workflow of QPS.

Survey System Integration

In the spring 2014 Saab Seaeye and QPS started to assemble a high quality survey system based on the Sabertooth and QINSy. This resulted in trials in September October where the system was put through a number of survey missions. To achieve the best possible data quality the sensors are synchro-

Figure 1 Sabertooth development



Using hybrid AUVs and state of the art hydrographic data acquisition software

nized and timed to millisecond precision.

QINSy consolidates data acquired from different sensors in real-time and can process this data at the same time. All data can be viewed in various dedicated displays which allows for real-time QA/QC of the data.

The following sensors were integrated for the trials:

- *Edgetech 2200 combined SSS and SBP, Simultaneous dual frequency SSS: 230/850 kHz, 2-16kHz chirp SBP*
- *BlueView M900-2250 (dual frequency, 900kH and 2.25MHz), 130 degrees field of view imaging sonar*
- *Tritech parametric sub bottom profiler*
- *R2Sonic 2024 MBES with external SVP for SV compensation*
- *Phins III INS with RDI DVL*
- *AXIS industrial grade HD IP camera*

The reason why QINSy has been this successful is due to the flexibility of the software, it can be used for many different types of operations, such as dredging, hydrographic surveying, oil rig positioning and ROV positioning and surveying. It has support for more than a thousand different systems and interface protocols. The choice to have QINSy on-board of the Sabertooth system was therefore not difficult.

The QINSy software is installed on a computer on-board the Sabertooth and is configured to do real-time data acquisition of interfaced systems such as INS, multibeam echosounder, sidescan sonar, pipetracker and sound velocity profilers. In addition it is also configured to process the multibeam and sidescan data in real-time.

QINSy is closely linked to the Sabertooth Control System (ICON) as shown in the block diagram. This allows the QINSy system to be controlled according to the mission planning system, setting parameters and sensors for various parts of the mission. In addition the Sabertooth behaviour based control system is able to use data processed in the QINSy system to enable tracking of bottom features such as pipelines.

The tasks of QINSy on-board the Sabertooth is to meet the highest standards for hydrographic surveys, send and receive critical information to and from the Sabertooth ICON system. Besides that QINSy performs the data acquisition and storage

Figure 2 Integration block diagram

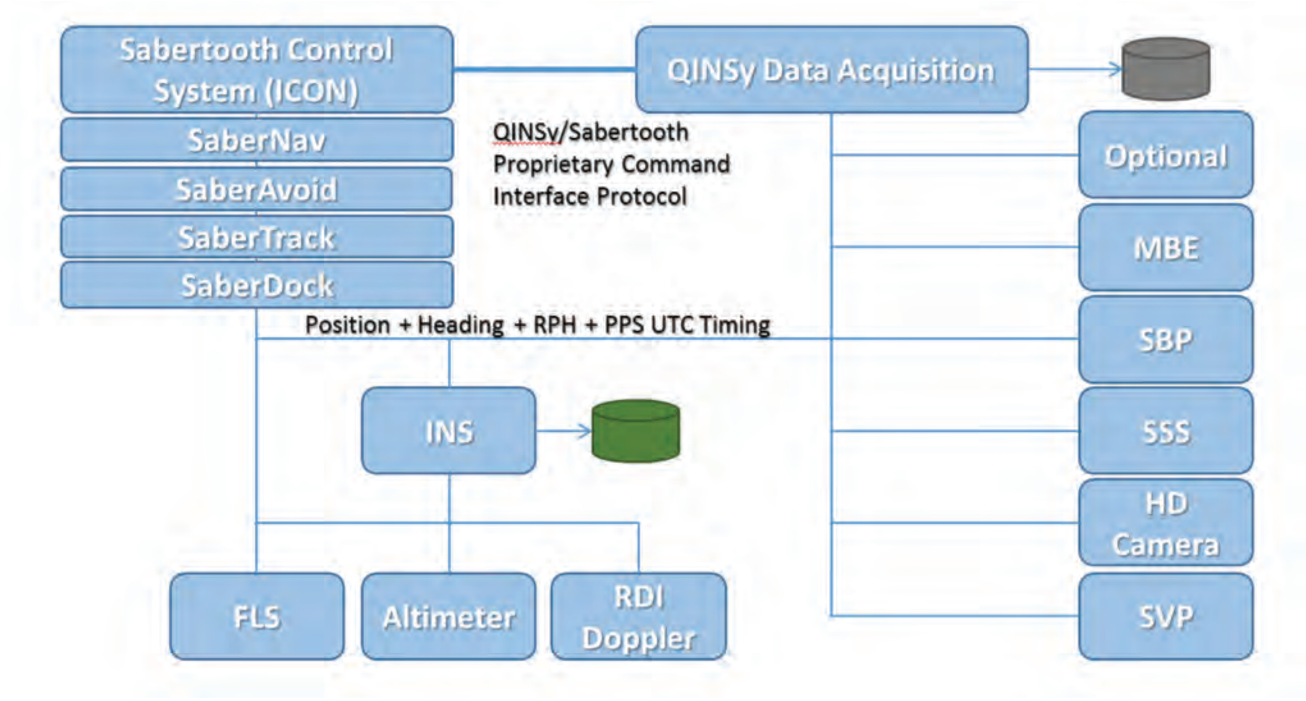


Figure 3 Sabertooth with the survey sensors installed

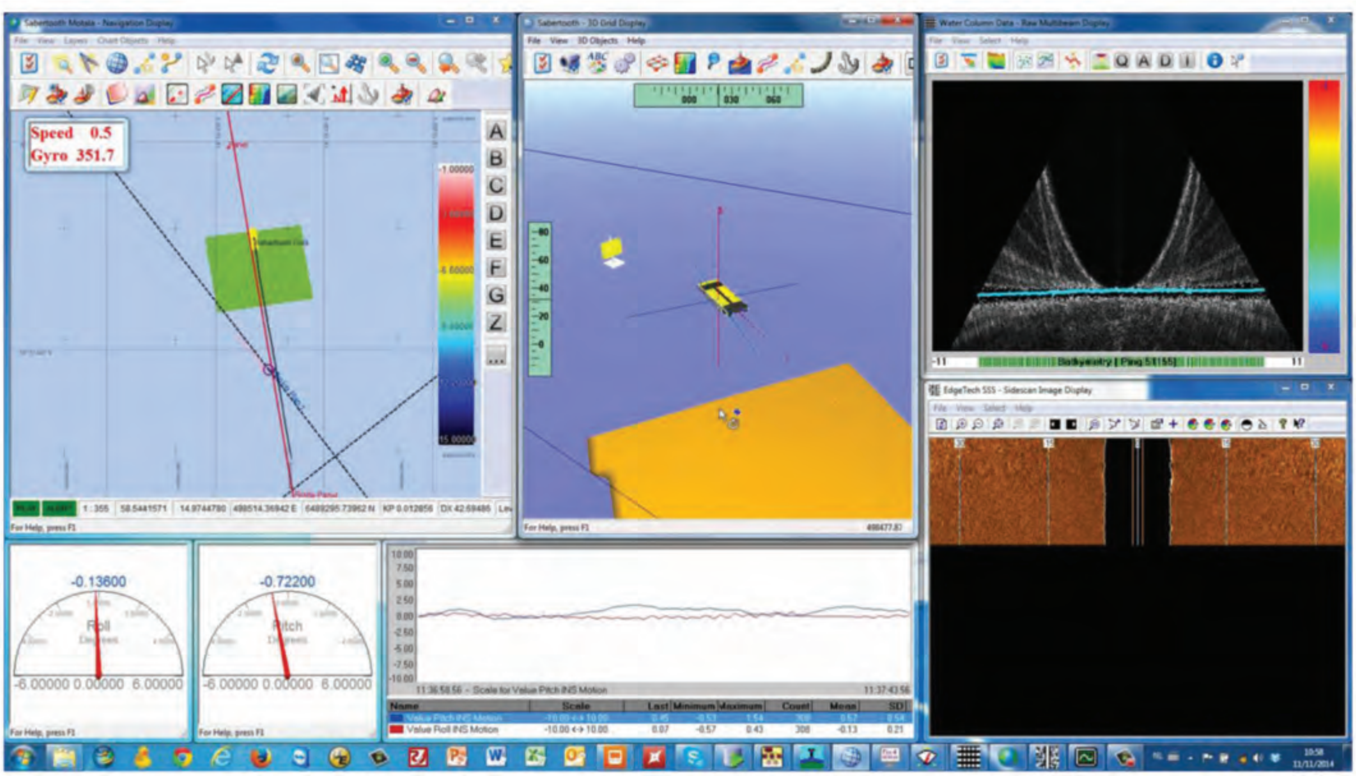


Figure 4 Real time display during trials

of raw sensors, it is also able to control sensors that are onboard the Sabertooth.

The Sabertooth is also extremely flexible in that it is able to operate in various modes such as Tethered mode, Acoustic modem mode and Autonomous mode.

In tethered mode the AUV has a fiber optic tether which allows for monitoring the data from topside. A typical usage for this mode is in remote real time inspection work.

In acoustic mode there is communication from topside to the AUV through an acoustic modem. The AUV can perform a mission and there is some monitoring of progress and the option to intervene in a mission.

A fully autonomous mode is whereby a mission is preplanned and will operate on its own. In this mode it is still possible that QINSy send processed data to the Sabertooth Control system for guidance aiding.

During the survey with Sabertooth, QINSy is able to record and visualize (depending on operation mode) real time the measured seabed, as well as backscatter information and visualize the water column data from the multibeam. This data can be combined with other real time collected data such as sidescan sonar and in the near future also subbotom profiling, providing extra information which can be very useful for decision making or to modify the mission of the Sabertooth. Typical products generated by QINSy are the raw data files, point cloud data files and gridded data. Each file

contains a huge amount of Meta information that can be used for quality control and seabed interpretation.

After the survey the data can be retrieved from the Sabertooth in case it didn't immediately send over the data to shore. The collected data can be further processed to a finished product and the results can be analysed using Qimera and Fledermaus software tools that are part of the QPS Hydrographic workflow.

Qimera is a brand new tool for multibeam processing, and has the ability to work with raw as well as processed data of the multibeam. Post-processed trajectory data of the Sabertooth can be brought into Qimera to improve the seabed data.

Additionally Fledermaus has the ability to process the backscatter data using the Geocoder engine for creating a mosaic and to do a sediment analysis, furthermore the water column data can be investigated for features on the seabed or above the seabed that have not been picked up by the bottom tracking algorithm of the multibeam. With the Water Column Data processing it is possible to visualize and extract these features such as natural and artificial gas seeps, or manmade objects like chains, ropes, or the top of the mast of a wreck.

When all the data is processed and gathered it can be visualised in a 3D scene, showing all the different produced products generated from the different sensor data. This can then be combined with the Sabertooth vehicle track, recorded video and still images and be played back creating a 4D view.

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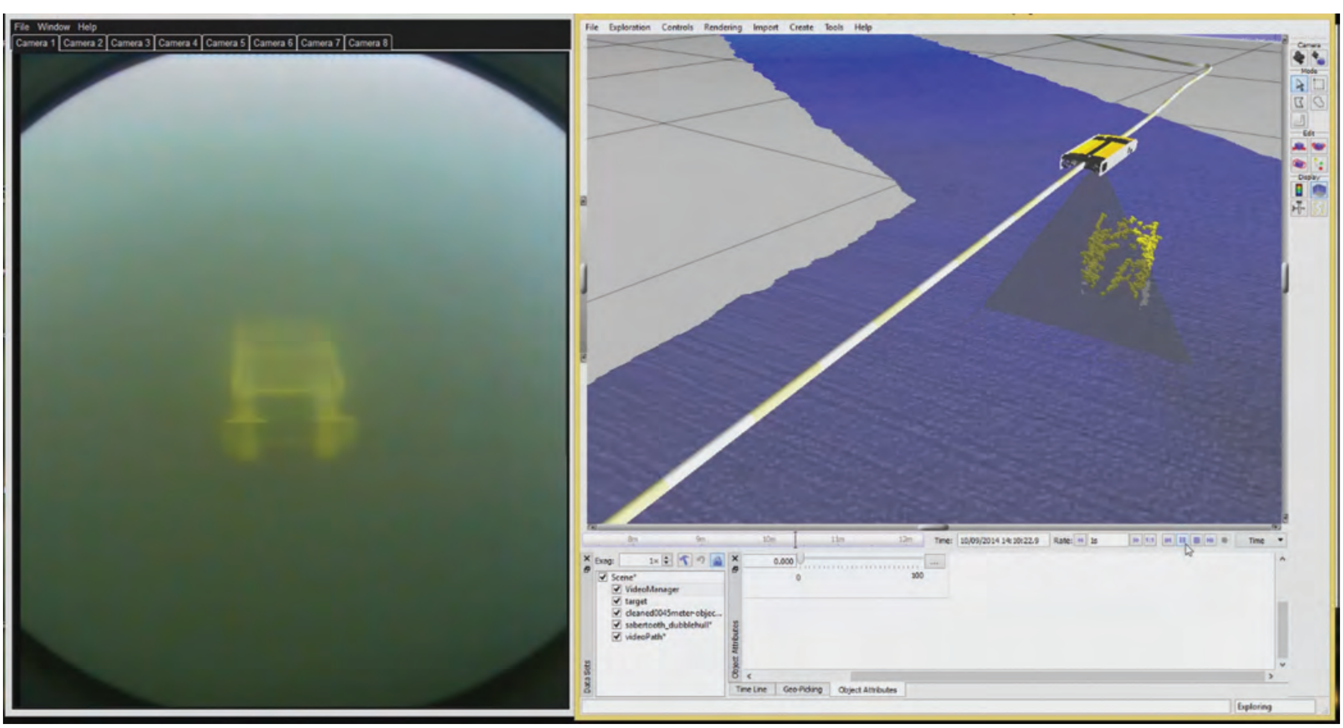
Figure 5 QPS Fledermaus 4D scene with integrated video imagery



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Data • Xchange Delivers

AML Oceanographic's recently released WiFi & GPS device, Data • Xchange, is saving time for hydrographers around the world by transferring and exporting data wirelessly and automatically.

The old adage holds true in hydrographic surveying: time is money. With daily operating costs in the thousands, workflow efficiency impacts a project's cost significantly. In March of 2015, AML Oceanographic launched Data•Xchange, a WiFi device with integrated GPS designed to increase efficiency and automation in the historically tedious process of SVP data collection. Upon surfacing, Data•Xchange transfers collected data through an automated WiFi link between profiler and computer at a rate 40 times faster than via cable. The former requisite of plugging and unplugging cables is eliminated, improving workflow by streamlining the process. This small addition to X•Series profilers is making a big difference in hydrographers' daily work.

Beta Trials

As a product inherently different than AML's usual developments – instruments and their sensors – preparing Data•Xchange for release presented new challenges with a correspondingly high engineering risk profile. Seamless install and use were paramount. "We wanted to be sure we got it right," explained Dustin Olender, Director of Engineering at AML. To graduate Data•Xchange from hypothetical process to real world workflow, Beta units were sent out to customers to test in the field. A crucial stage in the creation of the finished product leaving AML's warehouse today, the Beta trial program began in December of 2014 and finished in early 2015. Participating organizations included Canadian Hydrographic Services, Seahorse Geomatics, Public Works & Government Services Canada, QinetiQ, eTrac Inc., and others through AML's agents.

eTrac Inc.

A company particularly keen to try Data•Xchange was eTrac Inc. A hydrographic services firm headquartered in San Ra-

As the instrument emerges, Data•Xchange reconnects and transfers all files to SeaCast, where the data is immediately exported to all the file formats selected.

fael, California, eTrac was recently awarded a 5 year contract under NOAA's Office of Coast Survey to perform hydrographic surveys to aid in the updating of published nautical charts. The projects cover large areas and create a scenario where efficiency of SV profile collection is critical to production rates. Therefore, eTrac was on the hunt for products that aided in timely SV collection. "As owners and users of multiple AML SV Probes, the beta trial of Data•Xchange was a natural interest for us," explained David Neff, a Certified Hydrographer at eTrac.

According to Neff, Data•Xchange's positive impact on their daily operations has been multi-faceted:

> ***Data•Xchange allows us to collect SV profiles and make them immediately available to the hydrographer without the added time consumption of unplugging/plugging in the impulse/serial connection. The time and cost savings become significant when performing projects requiring multiple weeks or months of data collection. Additionally, by eliminating the constant unplugging/plugging in of the standard impulse connector, Data•Xchange alleviates wear and tear of the connectors, which ultimately helps us save on maintenance costs.***

eTrac recently completed a large scale mapping project in the Gulf of Mexico covering the Approaches to Panama City, Florida. Data•Xchange was implemented on one of the two survey vessels in an attempt to gain efficiency and streamline SV collection. Neff added, "Data•Xchange was helpful to the project and we look forward to including the product in our future operations."

Trial Benefits

For participating organizations, the Beta trials were a chance to be on the cutting edge of profiling instrumentation tech-

> ***"We wanted to be sure we got it right,"***
> ***Dustin Olender, AML Director of Engineering,***
> ***on sending Beta units out into the field with customers.***

nology. In return, they helped AML's engineering team work out low frequency, low severity bugs or feature requests, such as clarification on the new SeaCast 4 interface, or installation issues relating to quirks in older versions of Windows. The engineers who had designed Data•Xchange from its infancy interviewed hydrographers working with the product in the field. Upon finding a problem, they would work with the customer over the phone or via the web to isolate and then solve the issue. In all aspects of the product - but especially with SeaCast 4 - the goal was to simplify and automate the experience, even as new features and options were being added to address customer needs. For example, there was a request from a trial participant to provide concatenation of CARIS files via SeaCast. This function was implemented prior to SeaCast 4's release. The trial provided AML engineers with a much better sense of the specific applications and needs of the customers, resulting in a product more attuned to its operator.

SeaCast 4

The launch of Data•Xchange coincided with the release of SeaCast 4, the latest version of AML's data capture and processing software. While previous versions already provided an intuitive interface with all X•Series instrumentation, SeaCast 4 features enormous enhancements in instrument setup and data collection, management, and exportation. One such feature is automatic, simultaneous exports to multiple hydrographic software file formats, including HYPACK, CARIS, CARIS concatenated, Quinsy, Kongsberg, Sonardyne, PDS 2000, HIPAP, and CSV. With many of the new version's improvements directly enabled by and for Data•Xchange– such as embedded GPS to georeference cast data – their interaction produces optimal efficiency.

Why WiFi over Bluetooth?

In the early stages of development, the product design team determined that WiFi would be the optimal choice considering the operations for which the device would be used. That is, when hydrographers are in the field and profiles are being taken at various distances from the vessel's computer, WiFi would perform best given its proven superiority in range and

When Data • Xchange connects with SeaCast, instrument and sensor details – along with key indicators of instrument status – are displayed automatically.

SVP Data Collection

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> ***"Since introducing Data•Xchange into our data acquisition environment, eTrac has experienced greater efficiency in SVP profile collection and reduced wear and tear on connectors. We look forward to using Data•Xchange on future projects."***
>
> ***David Neff, eTrac Inc.***

data transfer rates. Although some Bluetooth specifications suggest a long range, the reliability at those longer ranges is questionable. WiFi is also the more secure wireless connection, with tried and true 128-bit encryption.

Connector Wear

Another key benefit of Data•Xchange is the reduction in subsea connector cycles. Frequent connector mating adds to the risk of connector wear and, ultimately, instrument failure. Every connector cycle increases wear on the conducting pins and sockets, and also presents the risk of dirt or debris entering the connector mate. With a choice of sleep settings to match various workflow requirements, Data•Xchange drastically reduces the mate cycles from multiple per day or per cast to just one when charging the battery.

Data•Xchange: For X•Series Profilers New AND Old

Backwards compatibility was seen as critical given the large install base of X•Series profilers. "When designing this product, we made backwards compatibility an absolute must. It was important to us to make sure existing customers could experience the benefits of Data•Xchange without having to purchase a brand new instrument," explained AML's President, Robert Haydock. Also important was staying true to the modularity of X•Series and Xchange™ products: Data•Xchange can easily be moved amongst all X•Series profilers.

The benefits to survey operations are clear. Automation of data transfer and exportation greatly improves data collection workflow for hydrographers. Time savings are realized immediately with the first use of this technology, while reduced long term wear and tear on the cabling and connectors provides further long term benefits. Data•Xchange is a valuable upgrade to any hydrographer's survey kit.

eTrac Inc. *offers a full range of services from large and small scale hydrographic survey, to custom integration and systems design for a variety of hydrographic applications. Beginning as a small firm in 2003, eTrac has added offices in Seattle, Anchorage, and Houston and grown to approximately 25 employees, 9 vessels, and an array of hydrographic equipment servicing several markets across the United States' west coast, including Alaska.*

AML Oceanographic Ltd. *designs and manufactures innovative instruments for the ocean sensing market. Having pioneered the design of field-swappable sensors and the industry's only proven UV biofouling control products, UV•Xchange and Cabled UV, AML provides a full spectrum of instrumentation solutions for hydrographic survey, environmental monitoring, and other applications.*

For more information on Data•Xchange, SeaCast 4, or other products please go to **www.amloceanographic.com** or contact **sales@amloceanographic.com**.

Preparing to use Data•Xchange is easy. Just slide it through the shackle extender and plug it into the instrument.


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Latest news
Sens. Menendez, Booker Urge Feds to Expedite Road Salt to NJ
NJDOT wants Jones Act Waiver. U.S. Senators Robert Menendez (D-NJ) and Cory Booker (D-NJ) have jointly sent a letter to both U.S.
Regs4ships Launch Australian Digital Product
Regs4ships announced the launch of its 18th flag to Digital Maritime Regulations (DMR) product. From February 18
Chautauqua Lake Airplane Crash Exercise Scheduled
Personnel from the U. S. Coast Guard, Chautauqua County, Lakewood Fire Department, the State of New York
EnSolve Launches Scrubber Water Treatment System
EnSolve Biosystems announced today that it has developed a new product called EnScrub which treats particulates and petroleum hydrocarbons from the
Jaya Delivers Vessel to Atlantic Towing
Offshore energy services provider, Jaya Holdings Limited, has delivered its second newbuild ice class anchor handling tug supply vessel to Canadian
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Whether you are collecting hydrographic survey data, environmental data, or just positioning your vessel in an engineering project, HYPACK® provides the tools needed to complete your job. With users spanning the range from small vessel surveys with just a GPS and single beam echosounder to AUV systems, HYPACK® gives you the power needed to complete your task in a system your surveyors can master

HYPACK®'s SURVEY program provides you with the visual feedback needed to get your survey job done right, whether you are on a large ship or a small dinghy.

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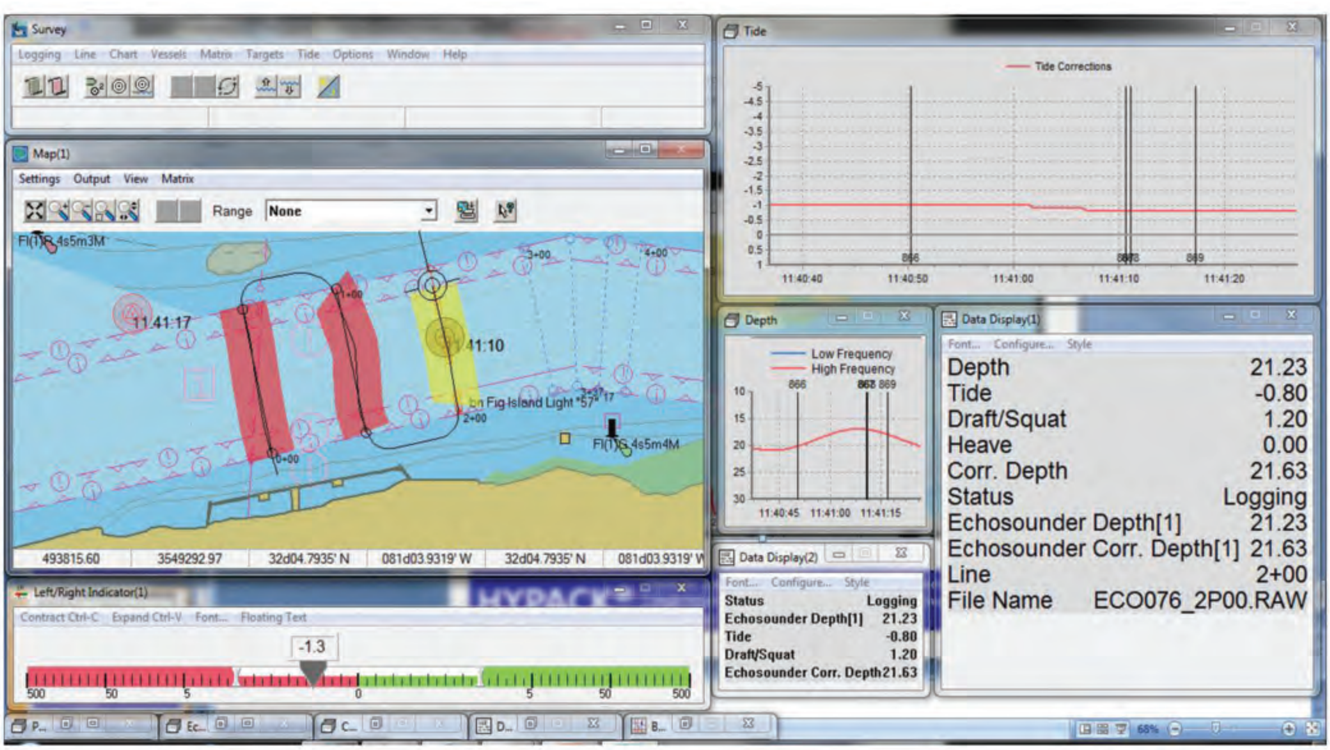
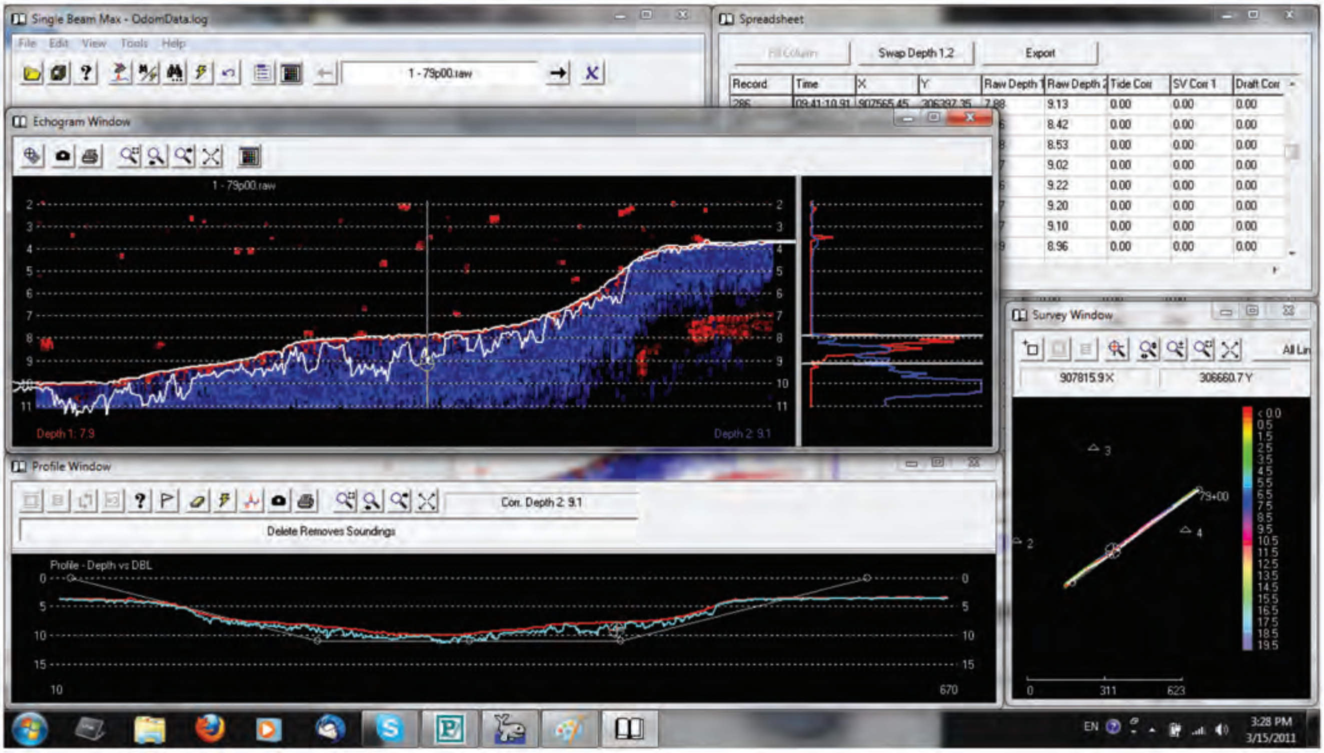
HYPACK® provides graphical editing and sounding selection routines that allow you to quickly prepare your survey data for plotting, export to CAD or several other final products.

Side Scan

HYPACK® is the only hydrographic software package that offers side scan collection, mosaicking and targeting as a standard part of our package. HYPACK® supports analog and digital side scans, including some of the latest dual frequency and high resolution side scans. The HYPACK® side scan processing routines accept input from side scan or from the





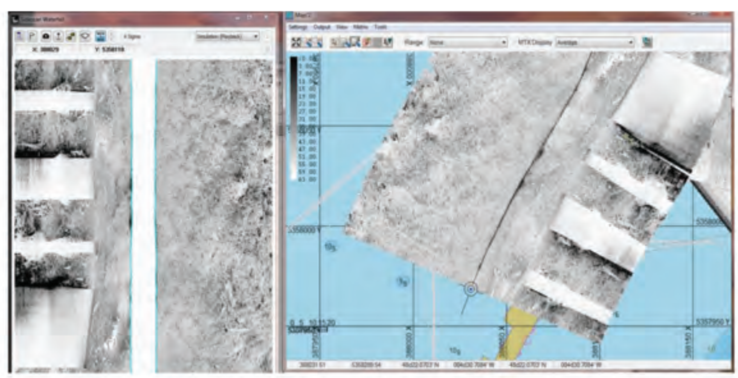
pseudo-side scan available from many multibeam systems.

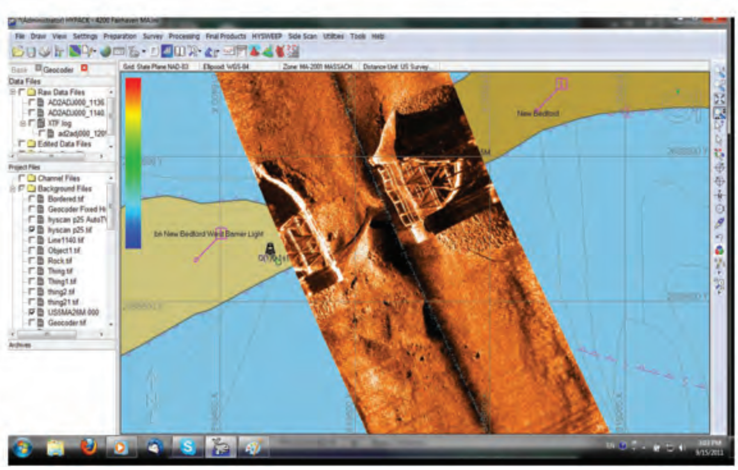
Targeting can be performed in real time, or in post-processing. Targeting tools can capture a GeoTIF image of targeted objects, make measurements of their length, width and height, and save the data with the position to a Target Group. A Target Report, in rich text format, can be emailed and reviewed by clients or home office staff in any word processor (eg. Microsoft Word®).

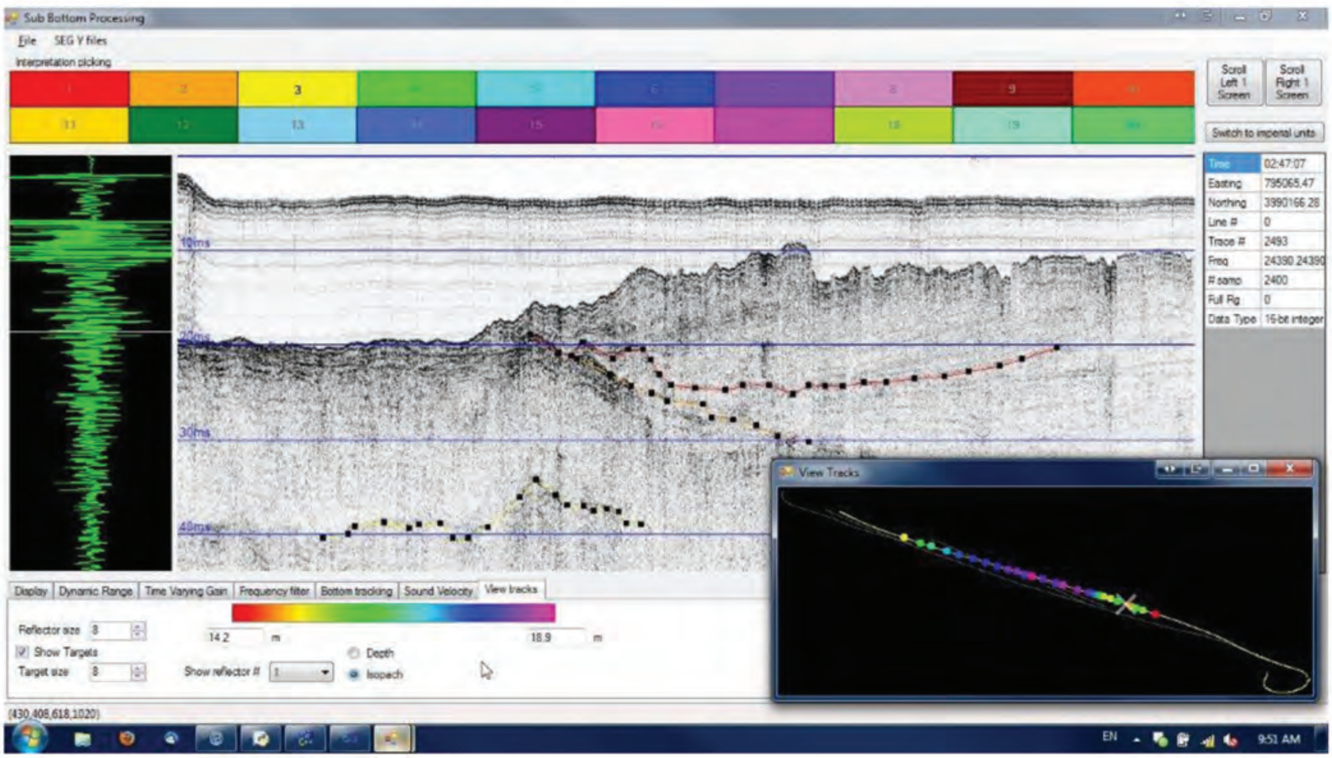
The GEOCODER™ program is integrated as a standard side scan processing tool. GEOCODER™ was developed by Dr. Luciano Fonseca of UNH-CCOM and provides advanced mosaicking and bottom classification routines.

HYPACK® allows you to process side scan sonar, snippets, and backscatter data collected in HYPACK® or data collected by 3rd party systems. Supported formats include: HYPACK HSX & HS2, XTF Side Scan, CMAX CM2, Edgetech JSF, Imagenex 81S, Klein SDF, Marine Sonic MST.

As one of the leading hydrographic surveying software companies in the world, HYPACK, Inc. continues to make improvements and enhancements to our software. In the latest version of SIDE SCAN SURVEY, users can generate a real-time side scan mosaic saved as series of geo-tiff images. The pro-







gram stitches the side scan images of the sea floor together to provide a quality preview of the mosaic created in post-processing. Gain, color controls and bottom track set in SIDE SCAN SURVEY are used to optimize the output mosaic display.

Sub-Bottom

HYPACK® allows you to collect, edit and review sub-bottom data collected in HYPACK® or other packages that produce industry standard SEG-Y files. HYPACK® supports both analog and digital sub-bottom systems.

The SUB-BOTTOM PROCESSING program accounts for different velocities for the water column and bottom material, and provides filters to enhance your data display. During processing, you can digitize up to 20 different reflectors and mark targets (position only or position and depth- of- burial). The program then saves your data to industry standard SEG-Y files. Sub-bottom Processing is a standard feature in HYPACK®.

Multibeam

HYSWEEP® is the HYPACK® multibeam and laser scanner package e where you can calibrate, collect and process multibeam, multiple transducer and topographic laser data. HYSWEEP® has been integrated to almost all multibeam systems in the market. With over 4,000 HYSWEEP® users on six continents, HYSWEEP® has proven to be powerful, cost effect and easy to learn.

HYSWEEP® SURVEY provides you with coverage diagrams, real-time TPU displays, and QC tools needed to efficiently complete your multibeam survey.

The REAL-TIME POINT CLOUD runs in conjunction with HYSWEEP® SURVEY and displays both multibeam and topographic laser data in a corrected and geo-referenced, color-coded point cloud. The REAL-TIME POINT CLOUD program provides easier feature detection and categorization, system calibration and verification, and data quality control.

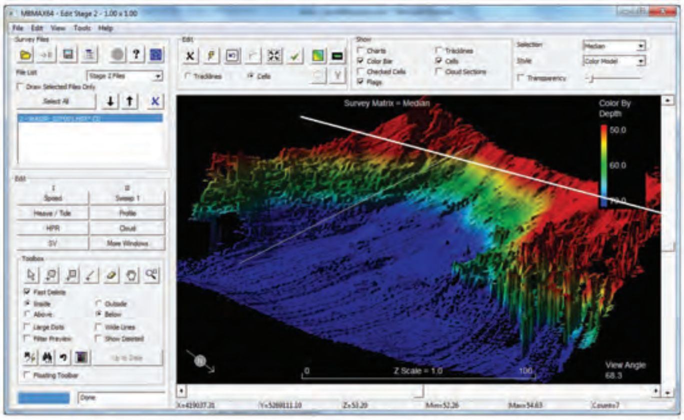
The HYSWEEP® EDITOR allows you to review your raw data components, incorporate sound velocity and water level corrections (including RTK tides and VDatum), and apply geometric and statistical filters to quickly clean your data and output a variety of data subsets.

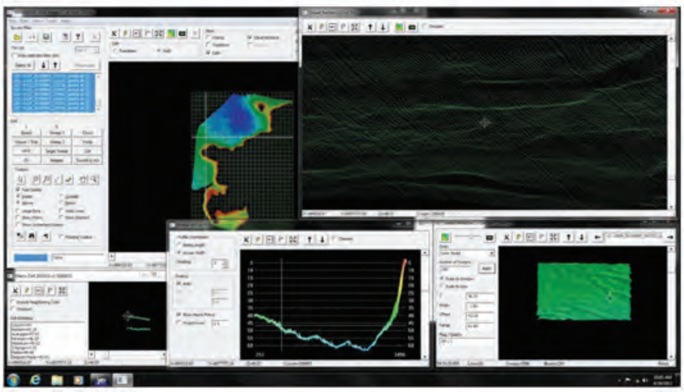
Laser Scanner

The HYSWEEP® software module in HYPACK® provides data collection of multibeam and LIDAR scanners with full editing capabilities.

HYPACK, Inc. recently announced the integration of the Velodyne Laser Scanner with HYPACK® 2015 as the standard solution for anchor handling and positioning applications.

Dave Maddock, of HYPACK, recently integrated the Velodyne HDL-32E topographic laser to receive data from all 32 channels. The Velodyne HDL-32E laser measures only 5.7" x 3.4", can be mounted in a variety of angles and generates up to 700,000 points per second with a range up to 70 meters. The collaboration between HYPACK and Velodyne Laser

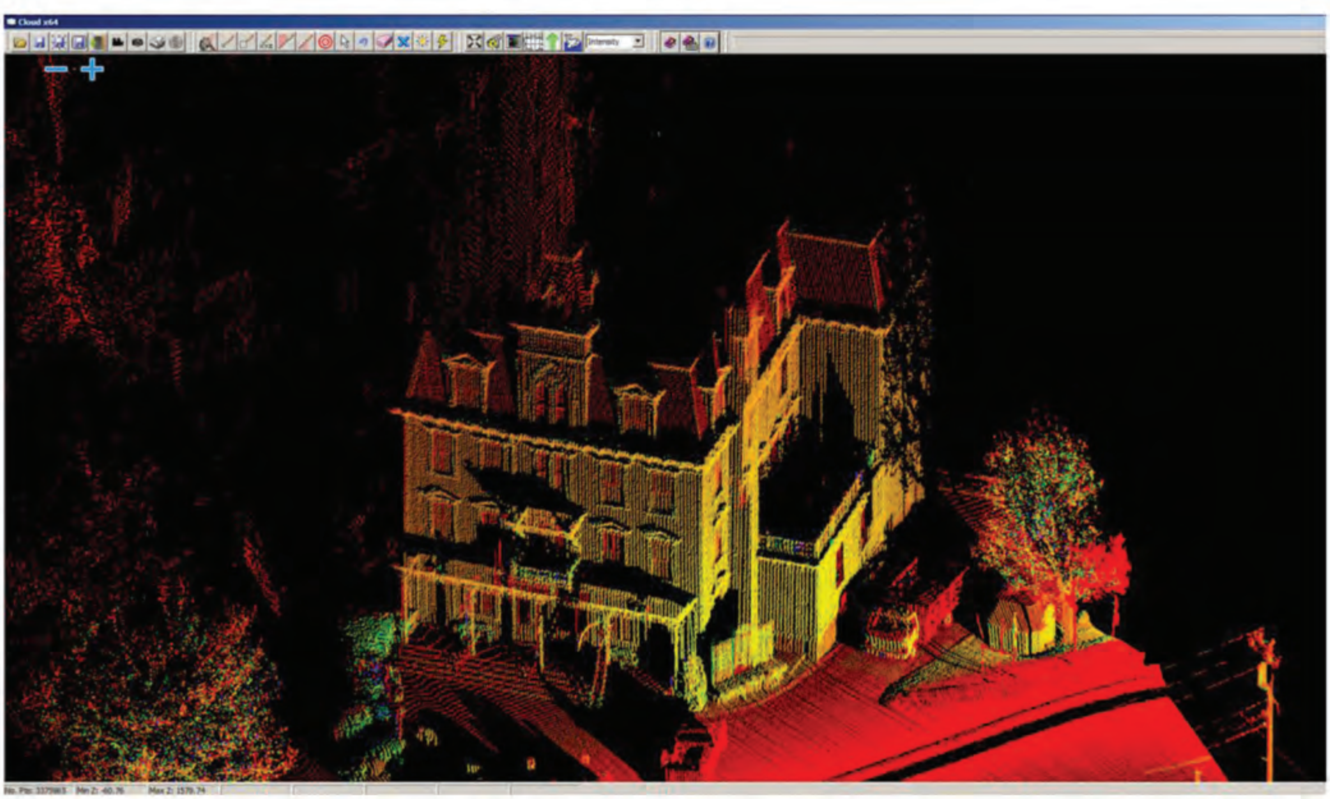




promises to deliver excellent results and benefits. HYPACK benefits from the Velodyne Laser extensive experience and track record as world leader in the marine construction survey industry. The selection of the Velodyne Laser compliments the existing HYPACK® and HYSWEEP® software.

HYPACK also recently ran a field test with the Dynascan M250 LIDAR scanner in HYSWEEP®. The Dynascan M250 is a complete LIDAR system with integrated RTK GPS and motion reference unit.

For more information on our company and software please visit us at www.hypack.com. You can also stay updated with the latest news at HYPACK, Inc. by following us on our social media sites. See pictures, hot topics, press releases and new product information on Instagram, Facebook, Twitter, LinkedIn, and YouTube; and follow us through our journey in making hydrographic surveying a more efficient and accurate process.



New Algorithm for Multibeam Imagery Processing

By Eli Leblanc and Burns Foster

Introduction

Over the past years, multibeam echo sounders are increasingly being used not only to obtain water depth information, but also to record backscatter response. This information recorded by the sonar is very useful in studies on marine geology (Anderson et al., 2008; Harahap et al., 2010), underwater works and military applications, as it is possible to relate the acoustic intensity response with ocean floor properties(Applied Physics Laboratory, 1994; Eleftherakis et al., 2012; Huang et al., 2011).

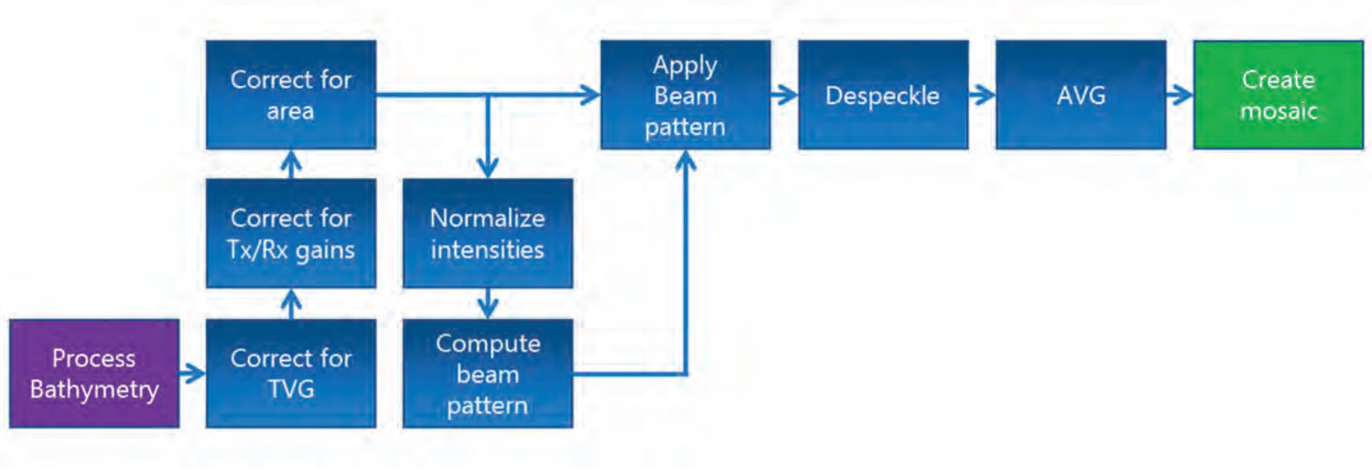
Part of the challenge of existing processing algorithms is to diminish or weaken the influence of local bottom slope and near nadir reflection on backscatter strength data. Furthermore, the well-known method to estimate the sonar beam pattern over a patch of flat homogenous and sandy seabed is not fully adequate, as most surveys are conducted on unknown bottom type, and the data includes the angular dependency signature of this sediment. With all of this in mind, a new robust, documented and standards-compliant algorithm for backscatter processing, currently being integrated into CARIS HIPS and SIPS™, is presented in this paper.

Material and methods

When implementing the algorithm, special care was taken to minimize user input. Most of the online parameters (frequency, along and across-track beamwidths, transmit power, receive gain, pulse duration, nominal spreading and absorption, sound speed) are read directly from the raw sonar files, along with the necessary raw data (beam angles, range and intensity). These parameters are combined with the processed bathymetry. Local temperature and salinity (on a broad scale) are the only parameters that are required from the user.

The new algorithm (Figure 1) is based on the assumption that after rigorous corrections have been applied to the individual raw backscatter intensities, the resulting fluctuations should be due to the sonar spatial angular spectrum (beam pattern)

Figure 1: New algorithm process diagram.
The purple box represents geometric corrections and the blue boxes radiometric corrections.



and the seabed geoacoustical properties and their relation with the grazing angle. The beam pattern is characteristic to the sonar on a particular installation so it is appropriate to use an in-situ approach to estimate it (De Moustier and Kraft, 2013). We can assume that the modulation introduced by the different angles of incidence and bottom types is fluctuating around a mean value. When enough data is fed to the beam pattern estimation, these variations should average out and a clear beam pattern should emerge. The resulting beam pattern can then be removed from the corrected intensities. After an angular varying gain (AVG) is applied to remove the angular dependency, or the typical response of the sediment to the angle of incidence, the resulting values are used to create a mosaic that should only represent sediment reflectivity.

Geometric corrections

The geometric corrections are necessary to translate two way travel time, angle and geographic positions in x-y-z coordinates, and to compensate for vessel motion, tide and refraction in order to compute precisely georeferenced soundings. These calculations are done through traditional means using long-standing functionality in CARIS HIPS and SIPS. The final positions will ultimately be used to create the mosaic. The resulting bathymetry will also be needed to compute the surface normal when correcting for the ensonified area.

Radiometric corrections

Radiometric corrections remove intensity fluctuations that are due to the sonar characteristics and processing, as well as the signal degradation and interaction with the environment that occurs between transmission and reception. These processing steps include correcting for the time-varying gain (TVG) applied at acquisition, for the transmission power and reception gains, for the ensonified area, and for the sonar spatial beam pattern and angular dependency.

TVG

A TVG is used to optimize the dynamic range and compensate for transmission loss that increase with range across the swath. The algorithm used to perform this real-time correction is specific to each sonar and normally uses a nominal value for absorption. The TVG applied at acquisition must therefore be computed and removed from the raw measurement and replaced by a transmission loss correction, taking a real local absorption. The local absorption is computed from the Ainslie and McColm model (1998), which requires the user to enter local values for temperature and salinity.

Transmission and reception gains

During acquisition, the transmitter power, and receiver gain typically can be set by the user or automatically adjusted by the sonar acquisition software. In either case, it can vary from ping to ping so it is important to remove them and replace them by a common reference.

Ensonified area

The area ensonified by the beam at the time of bottom detection is the intersection of the combined transmit and receive footprint with the pulse footprint on the bottom. The geometry and size of this intersection will vary with range, angle, transmit and receive beamwidths, pulse length and local slope. The instantaneous ensonified area is computed assuming an elliptical cone for the beam footprint and a spherical shell for the pulse (de Moustier and Alexandrou, 1991) and considering the surface from the neighboring soundings or bathymetric surface. Because the energy that scatters back to the receiver is proportional to the area of the reflector, the intensity corrected for gains is then normalized by the ensonified area.

Normalization

At this point, the intensities corrected for TVG, transmit and receive gains as well as ensonified area for a particular pointing angle would still fluctuate not only with the reflectivity of the sediement, but also because a variety of bottom types will be ensonified at various incident angles. To limit the effect for these variations, the intensity corrected for the ensonified area is normalized by its projection on a plane perpendicular to the beam vector.

To account for small variations in transmit power or receive gains that some sonars apply even for a fixed sonar setting, the total power in the ping is also removed from each normalized intensity.

Beam pattern

The normalized intensities versus steering angle relative to broad side curve is then interpolated at a 0.1 degree interval for each ping and averaged over the whole survey area. The resulting beam pattern is then removed from the intensities corrected for ensonified area.

Despeckle

At this step, the outliers are removed to avoid the angular dependency curve becoming buried in noise. For each sample, the intensity is replaced by the mean value computed from its 8 neighbors from the previous and next pings and beams, if the difference between the current and mean value exceeds a threshold. The mean value is computed in linear units.

Angular variable gain

A simple AVG algorithm is implemented to compensate for the angular dependency. For a current ping, the previous and next number of pings are stacked. Each sample in the stack is

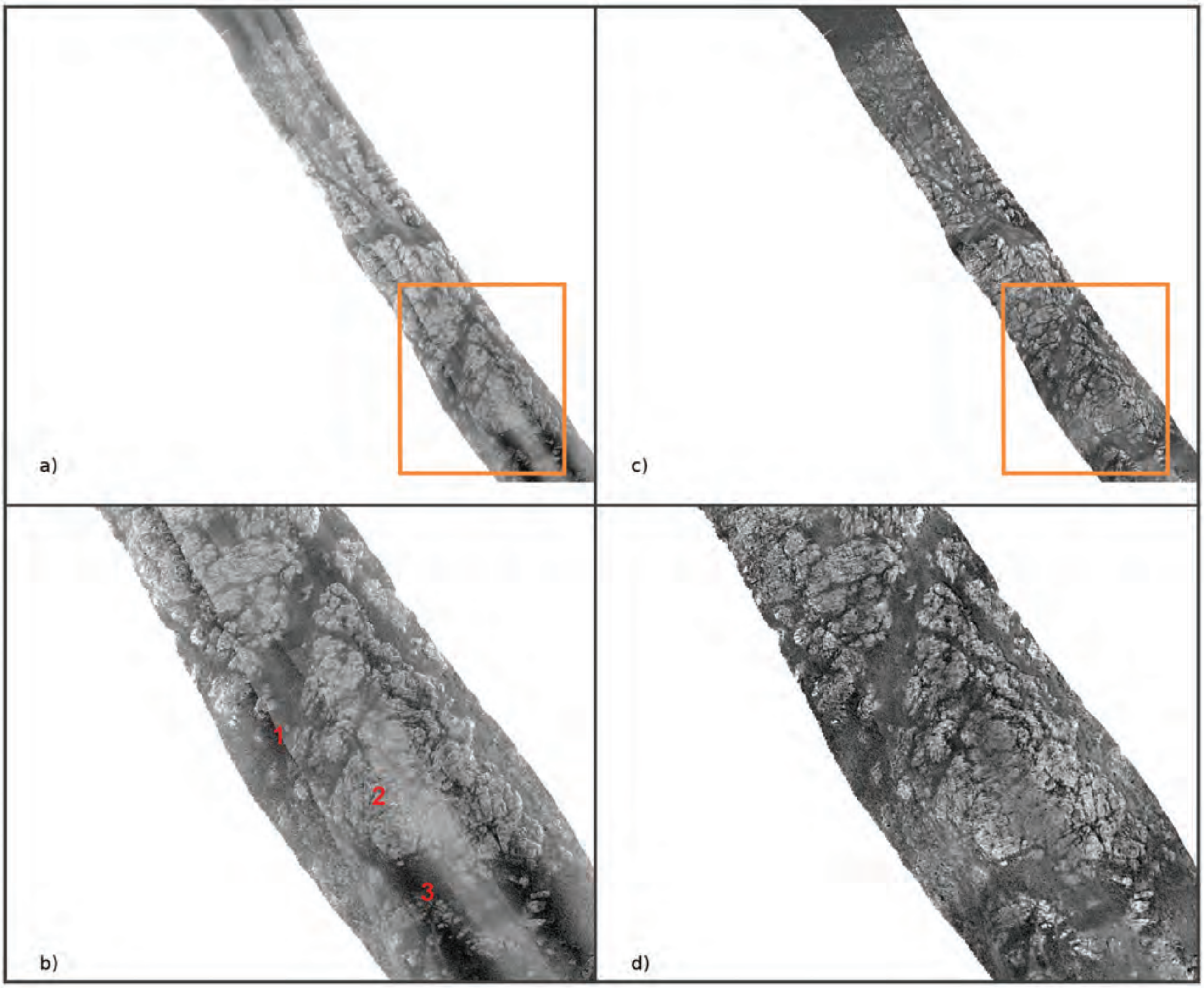


Figure 2: Results from the Shallow Survey 2015 dataset. a) raw mosaic (dB), b) zoom on the raw mosaic, c) fully compensated mosaic (dB), d) zoom on the fully compensated mosaic. The contrast of the mosaics were adjusted, removing 1% outliers, for better visualization.

indexed according to its signed incidence angle (negative for negative pointing angle) and the mean value is computed for each bin in linear units. The curve is then smoothed using a moving average and is normalized by the mean value in the 30-60 degree range. Each beam from the current ping is then corrected for the resulting curve.

Results

The new algorithm was tested on the common dataset provided for the 2015 Shallow Survey Conference. The beam pattern was computed over about 500 000 pings on various relief and bottom types.

The results for a portion of the dataset are presented in Figure 2. The raw mosaic is shown in (a) with a zoom on the orange box in (b). We can see (1) a strong discontinuity on the overlap between lines, (2) poor contrast on the features, and (3) a very strong angular dependency curve. While the eye can partly compensate for these artifacts and interpret the features, it would be very hard for an automatic classifier to obtain consistent results.

The fully compensated mosaic is shown in (c) and (d). We can see that the applied workflow is successful at correct-

ing the artifacts observed on the raw mosaic. The lines blend smoothly together, the features are clearly revealed and the angular dependency is not visible.

Conclusion

A new algorithm for backscatter processing for CARIS HIPS and SIPS was presented in this paper. This method incorporates industry-standard corrections based on tried and tested acoustic principles as well as a new approach to estimate the sonar beam pattern more accurately. The new workflow was tested on real data and the preliminary results are promising, showing good agreement on line overlap, distinct features and few visible artifacts.

Bio

Eli Leblanc joined CARIS as a developer in 2014. She has been involved in underwater acoustics R&D for almost a decade, from marine mammal vocalizations and shipping noise, to port infrastructure inspection, data quality assessment, macroalgae mapping and bottom classification. She holds a Master's degree in Engineering from the University of Quebec in Rimouski.

Burns Foster is the Product Manager for CARIS HIPS and SIPS. Burns has been with CARIS for 7 years, originally in support and training for processing-related CARIS products. He holds a Bachelor of Science in Engineering degree (Geomatics) from the University of New Brunswick.

References

Anderson, J.T., Holliday, D.V., Kloser, R., Reid, D.G., Simard, Y., 2008. Acoustic seabed classification: current practice and future directions. ICES J. Mar. Sci. 65, 1004–1011.

Applied Physics Laboratory, 1994. APL-UW High-Frequency Ocean Environmental Acoustic Models Handbook (Technical report No. APL-UW TR 9407). University of Washington, Seattle, WA.

De Moustier, C., Alexandrou, D., 1991. Angular dependence of 12-kHz seafloor acoustic backscatter. J. Acoust. Soc. Am. 90, 522–531.

De Moustier, C., Kraft, B.J., 2013. In situ beam pattern estimation from seafloor acoustic backscatter measured with swath mapping sonars, in: Proceedings of Meetings on Acoustics. Presented at the ICA, Montreal, p. 070013.

Eleftherakis, D., Amiri-Simkooei, A., Snellen, M., Simons, D.G., 2012. Improving riverbed sediment classification using backscatter and depth residual features of multi-beam echo-sounder systems. J. Acoust. Soc. Am. 131, 3710–3725.

Harahap, Z.A., Manik, H.M., Pujiyati, S., 2010. Acoustic backscatter quantification of seabed using multibeam echosounder instrument. Presented at the Third International Conference on Mathematics and Natural Sciences, Bandung, Indonesia.

Huang, Z., Nichol, S.L., Siwabessy, J.P.W., Daniell, J., Brooke, B.P., 2011. Predictive modelling of seabed sediment parameters using multibeam acoustic data: a case study on the Carnarvon Shelf, Western Australia. Int. J. Geogr. Inf. Sci. 26, 283–307.

Stephens, D.D., Diesing, M.M., 2014. A comparison of supervised classification methods for the prediction of substrate type using multibeam acoustic and legacy grain-size data. PLoS One 9.

LOW-LOGISITICS MARINE SYSTEMS ENABLE NEW APPROACHES TO SURVEY

By Arnar Steingrimsson, Teledyne Marine Systems

RAPIDLY EVOVLING TECHNOLOGIES

Unmanned maritime vehicles (UMVs) have been under development for decades. Since the late 1990s, several systems have evolved beyond research labs and have become commercial realities. These tools are now in routine use for scientific, commercial and military applications.

With robust vehicles available, logistics concepts are becoming a key element of UMV operations. All operators deploy UMVs for a purpose. Achieving that purpose safely at the lowest overall cost, or in the shortest time possible, is usually a key goal. The increased productivity of data collection in survey applications is enabled by new technology developments, especially modular and payload centric unmanned vehicles.

LOW LOGISTICS: MODULAR AUVS AND PAYLOAD CENTRIC ROVS

Low Logistics AUVS

Modular, low logistics autonomous underwater vehicles (AUVs) now provide a level of operational flexibility that was impossible to achieve with earlier monolithic systems. Fully modular, low-logistics AUVs with offshore survey capability were first deployed in the energy sector mid to late 2000s. The Teledyne Gavia AUV (Figure 1) is the primary example of a fully modular AUV that truly separates into independent modules (Figure 2). The Gavia is comprised of 20cm diameter cylindrical modules. A complete system can range from 1.85m long (60kg in air) to 3.2m (100kg), depending on the modules deployed.

Figure 1: The Gavia AUV

Figure 2: The Gavia modules are fully independent and interchangeable

Several fleets of Gavia vehicles now operate in locations around the globe, in depths up to 1000 meters. These AUVs are in service with navies worldwide and are used for a range of applications including search and salvage, mine counter measures (MCM), sonar training, and platform/sensor development. Commercial firms also employ them for applications such as pipeline route survey and inspection, a variety of pre and post construction support applications, and dredge monitoring. Universities engaged in robotics research and development and oceanographic and geophysical research are another user community. Each of these Gavia AUVs can be changed from one role to another in the field by swapping the survey, environmental sensing, battery, and navigation modules. In fact, there are examples of the commercial users renting academic payload modules to support critical mission requirements.

The advantages of a fully modular AUV system include: ease of deployment (Figure 3), ease of storage and transport to site (Figure 4), small deployment team, modular sensor platforms, ability to adapt the AUV capability in-theatre, and multiple swappable battery modules for tailoring endurance. Modular systems allow for fast mission-turn-around, ease of maintenance, and replacement of modules without losing operational capacity. In addition, future sensor solutions can be integrated into a module offline, and then added to the AUV in the field, enhancing capability. Modularity allows service life benefits of being able to replace individual modules due to obsolescence, technology advances, or changing capability requirements, without losing the operational AUV asset for an extended period for factory level overhauls or reconfigurations. Full AUV modularity answers the requirement for an asset that can be designated to a variety of tasks as they arise without being dedicated to one task, while allowing future upgrade paths.

Figure 3: The Gavia is easy to deploy (image courtesy NCS Survey and BP)

Figure 4: The Gavia modules are easily transportable

Figure 5: Teledyne SeaBotix Containerized Delivery System

REMOTELY OPERATED VEHICLES (ROVs): PAYLOAD CENTRIC "WORKSPECTION" SYSTEMS

Undersea inspection began with divers who were gradually replaced by Work Class ROVs. The ROV industry has a long history and has grown to significant size. While these ROVs are effective, they are certainly not seen as affordable. They are significant, yet necessary, investments that demand sophisticated vessels and trained operators. Offshore survey inspection has benefitted from work class ROVs with the new missions they can accomplish, but dramatic improvements in the economics of the application are still slightly over the horizon.

In contrast, small ROVs have advanced in capability and are significantly changing the economics of many missions. Available in many sizes and price ranges these ROVs enable rapid and effective inspection of the seafloor and structures. Though depth ratings of most small ROVs are not typically equal to work class ROVs, new technology has brought the deeper missions within reach of smaller systems improving economics as well as providing novel means of deployment. The Teledyne SeaBotix Containerized Delivery System (figure 5) allows for small ROVs to be employed for certain tasks which would typically require the much larger and costlier work class ROV.

An array of sensors support applications such as leak detection and pipeline imaging, and improved auto-pilots and subsea positioning reduce the burden on operators. The significant increase in the number of mini-ROVs deployed by police departments, universities, and other fiscally constrained operators is a testament to the economics of this class of UMV. While the user base is growing, the gap between the capabilities of work class ROVs and the mini-ROVs is closing. Select low-logistics ROVs now offer the high thrust to weight ratio required to support long tethers in high currents. Flexible architectures allow these ROVs to be adapted to powerful sensors without the high drag the "strap-on" approach imposes on micro-ROVs. Thus a low-logistics ROV can now support missions such as bridge piling inspections in extremely low visibility and high current environments. A previously slow, expensive, if not impossible task is now routine and economical.

ROVs have been adopting increased "autonomy" for many years. Improved station keeping and closed loop control, common in large work class ROVs, are now available features in miniROVs. Likewise, the evolution of modular payloads for AUVs will impact the future of ROVs. At Teledyne, the SeaRover class ROV (Figure 5a) is designed to provide both autonomy and an interface to high value sensors, such as imaging sonars, in a low-logistics high performance platform. The SeaRover can be adapted to carry the same payload modules as the Gavia AUV (Figure 5b). This would allow a customer to derive additional value from their investment in high cost sensors. For example, an AUV sub-bottom profile module could be moved from an AUV to an ROV to complete both broad area survey and detailed inspection for a client.


Teledyne Marine Systems Success
Undersea Systems that Deliver...
Profiling Floats
Autonomous Undersea Gliders
Autonomous Undersea Vehicles
Remotely Operated Vehicles
Flotation and Releases
Communication and Positioning
Deep Survey Systems
OFFSHORE SURVEYOR
TELEDYNE GAVIA
Leaders in Low Logistics, High Performance Systems
...Success in the Deep Ocean
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Figure 6a: The SeaRover ROV

Figure 6b: outfitted with AUV payload modules

THE FUTURE: HETEROGENOUS MODULAR SYSTEMS

Today, modular AUVs are supporting commercial, defense, and scientific users, providing improved economics and operational flexibility. Sensors continue to evolve and adapt to enable increased modularity on UMVs. This versatility is already at work with fleet users of Gavia AUVs in survey missions. Thus far, we have not yet seen modular payload architectures cross lines between different platform types. But, that is the next logical step. The exchange of payload modules between AUVs and ROVs or even pole mounting of sensor modules from a vessel of opportunity (figure 6) is easily implemented and should come on scene very soon. This will require operators to carefully track and manage vehicle configurations. Failure to note a 300m rated payload module is installed on a 1000m rated AUV could prove problematic. But, manufacturers with diverse vehicle portfolios can assist users by building in "smart" features in payload modules. A 300m rated module could announce itself to the host vehicle, which could then reject a mission profile sending it deeper than the safe rating.

The added value of modular architectures is just beginning to impact operations. The technology will advance quickly and UMV operators should begin planning for the capability today. Robust feedback between users and developers of these systems will ensure technical and logistic issues can be resolved early. Thus a significant expansion of the business and operational value is anticipated from heterogeneous modular UMVs in the future. With a wide variety of payloads and vehicles to choose from, survey operators will be able to manage their capital expenditures and optimize their operations. New technologies will continue to shape the future of seafloor survey and unmanned vehicles will be a key element.

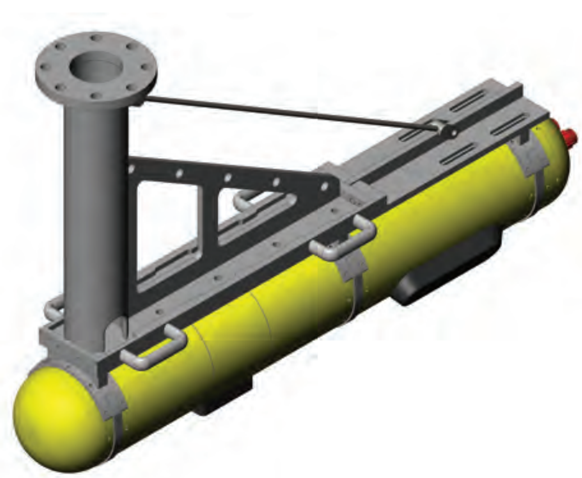

Figure 7: AUV payload modules pole mounted from a vessel of opportunity

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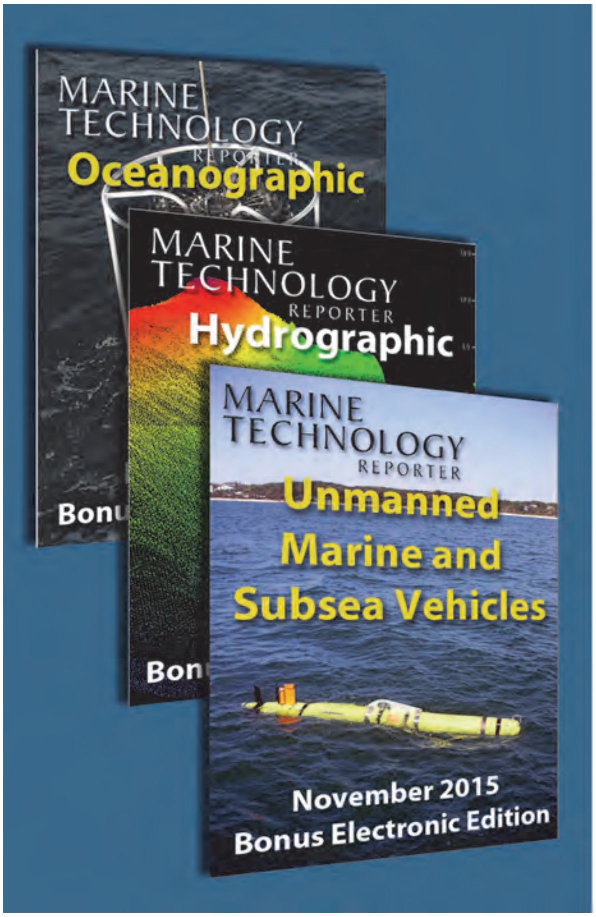

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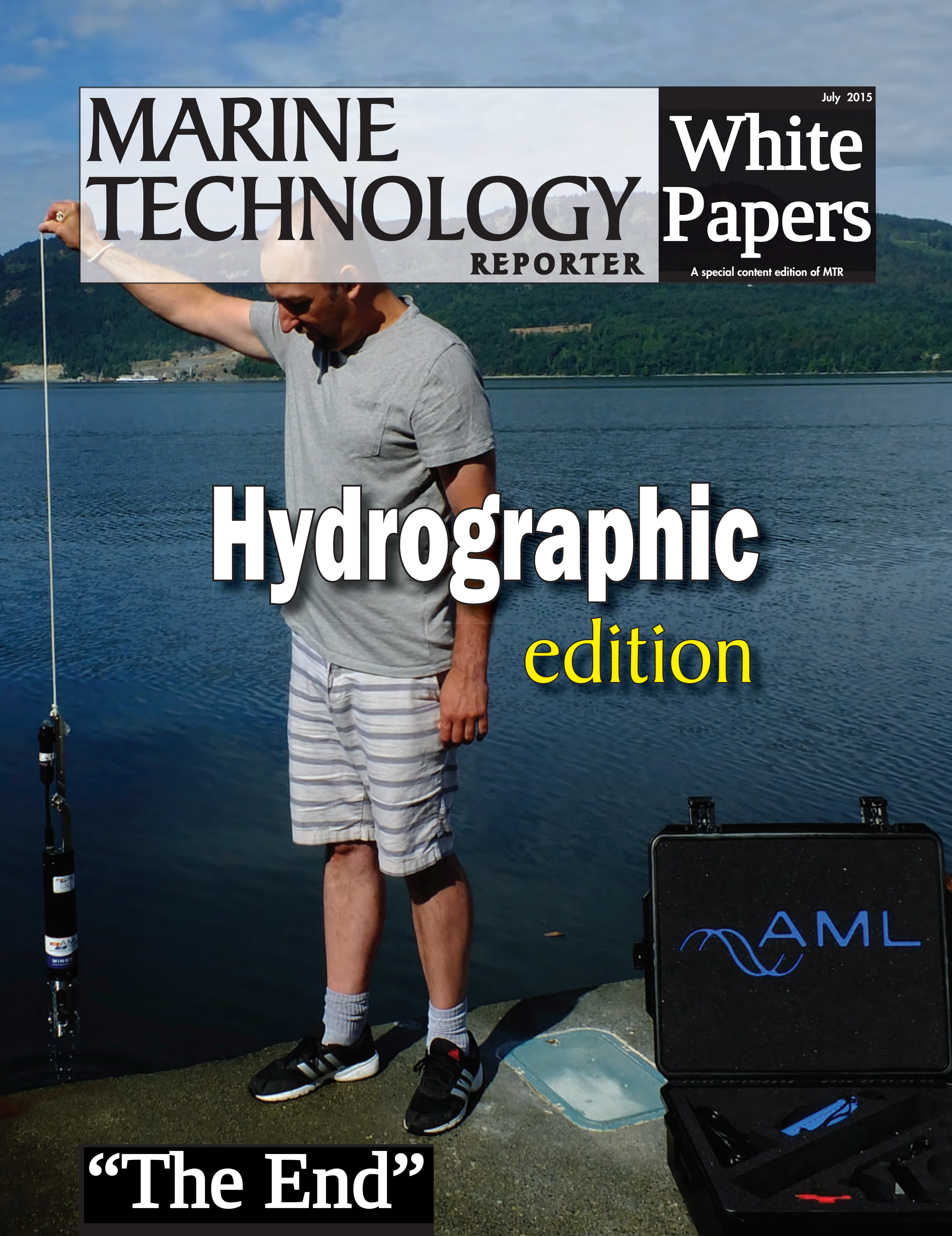

“The End”