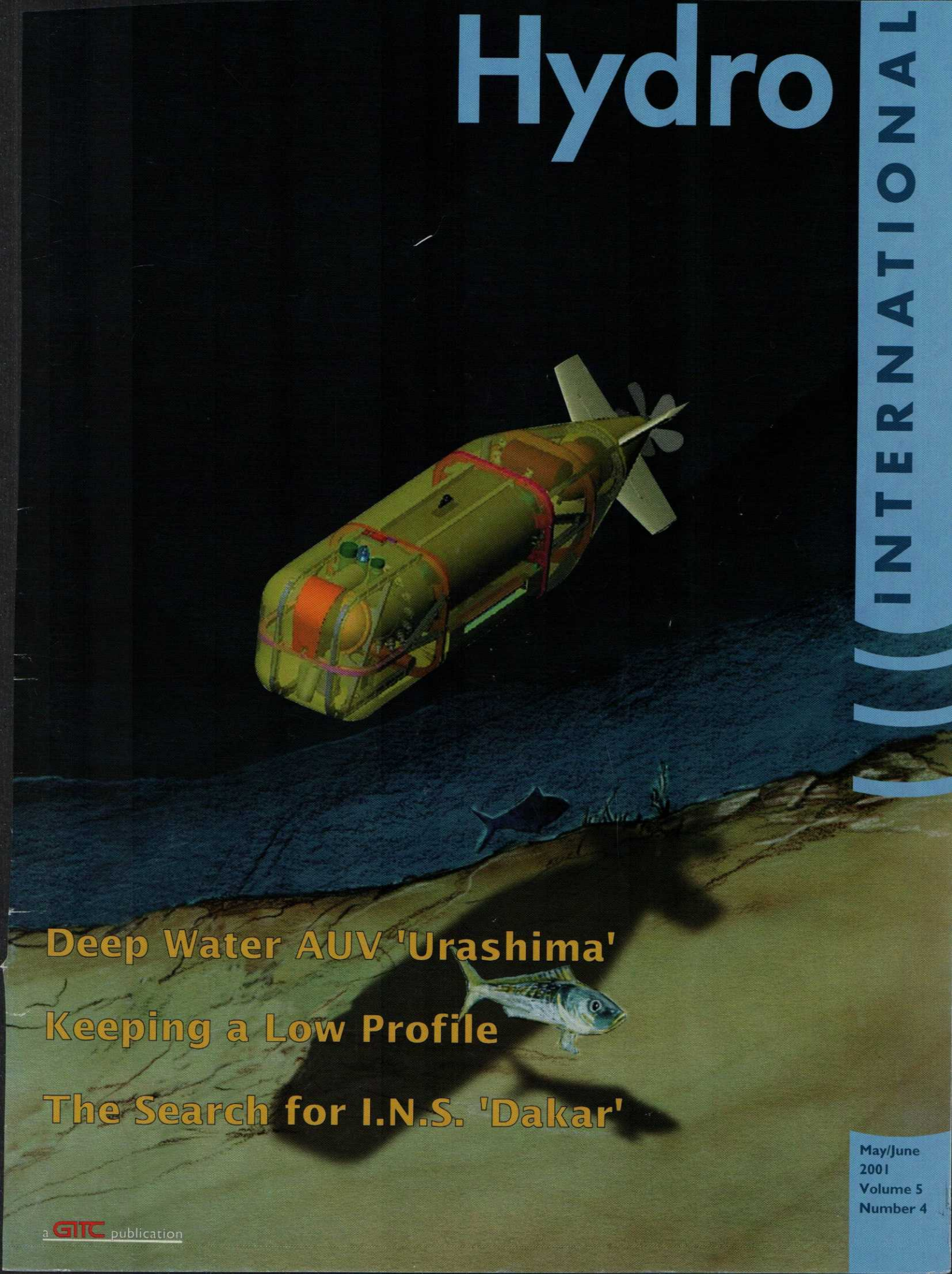
Hydro

INTERNATIONAL



Deep Water AUV 'Urashima'

Keeping a Low Profile

The Search for I.N.S. 'Dakar'

May/June
2001
Volume 5
Number 4

a GITC publication

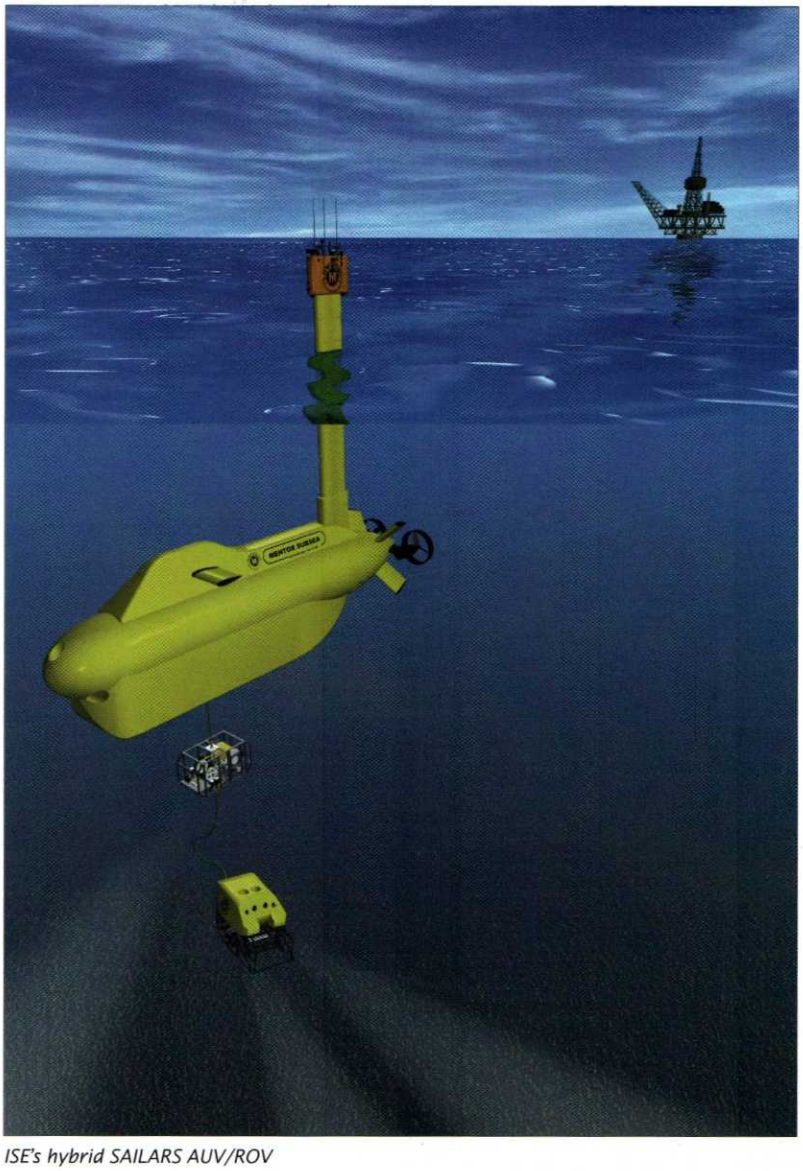
After two decades of development, primarily in academic and military institutions, Autonomous Underwater Vehicles (AUVs) are finally flexing their muscles on the commercial stage.

By Robert Wernli, SSC San Diego

The Commercialisation of AUVs

Who's leading the pack?

AUVs have moved from a state of research and development, through operational demonstrations and have now reached the beginnings of commercial acceptance. Although there were at least 66 AUVs being developed in 12 different countries at the end of the last decade, primarily in academic and military institutions, there were basically no commercially operating systems. But AUVs were on the cusp of the commercial acceptance curve, and last year that curve began to make an exponential change upwards. Today, commercial acceptance of AUVs offshore has begun. Vehicles such as Hugin (Norway), Maridan 600 (Denmark), AQUA EXPLORER 2 (Japan), Sea Oracle (US), SAILARS (Canada) and CETUS II (US), are being sold or developed for commercial applications, augmenting those AUVs already being used by academia and the military.



ISE's hybrid SAILARS AUV/ROV

What Is the Market?

Commercial

In the commercial sector, underwater survey in support of the oil and gas industry will initially dominate the market. The offshore market for AUVs has been analysed in detail by Douglas-Westwood Ltd of the UK; they envision two main groups of commercial AUVs-a survey AUV for data gathering and a hybrid AUV/ROV for subsea intervention.

The survey systems would be used to survey drilling sites and pipe routes, and they could also take in-situ soil measurements and measure seabed currents along the pipeline route. Douglas-Westwood estimates indicate that subsea drilling site surveys typically cost from US$ 150k-US$ 250k for shallow water, with two deep-water sites costing US$ 900k and US$ 1.4 million. In the case of the hybrid AUV, cost savings were not projected; however, the fact that floating production systems are supporting extensive undersea networks of wells, flowlines, risers and other subsea hardware, the potential savings for an AUV-based intervention system, operating from the floater itself, could be significant.

Another analysis by C&C Technolo-

gies, Inc showed that the total cost of a deep-water survey could be cut from US$ 707k using a deep-towed system (US$ 26k/day with ship) to US$ 291k using an AUV (US$ 55k/day with ship). That is a whopping US$ 416k (59 per cent) savings. A similar conclusion was also reached by the US Navy prior to the development of their 20,000 foot Advanced Unmanned Search System (AUSS). Analysis indicated an order of magnitude reduction in the survey time could be achieved at full ocean depth if an AUV was used. Thus, even considering the cost of transit time, the increased on-site efficiency of an AUV over towed systems is such that the overall cost will come down. Time is money.

The commercial potential of AUVs for offshore survey is projected by Douglas-Westwood in 'The World UUV Report.' If AUVs meet industry expectations, sales could reach 30 units by 2004 and they could account for 20 per cent of Unmanned Undersea Vehicle (UUV) operations revenue. The majority of this AUV operational revenue, which could exceed a cumulative total of US$ 200 million by the end of 2004, would be in the survey area. Whereas the ROV revenue is projected to increase by about 63 per cent from 2000 to 2004, AUV revenue is projected to increase by 5,500 per cent during the same period. Obviously, someone believes that AUVs have come of age.

Military

On the military side of the equation, AUVs have been under development for decades, and they are now reaching operational status. Their initial fleet application will be for mine hunting, which was also the mission driving fleet introduction of ROVs. However, in the case of the AUVs, they will operate from a submarine and not a surface ship. The US Navy's submarine-launched AUV is the Long Term Mine Reconnaissance System (LMRS), which is scheduled for initial operation in 2003.

An AUV similar to the LMRS, the Marlin, is being developed by BAE Systems for the UK's Defence Evaluation and Research Agency (DERA). Programmes are also ongoing in several other countries.

The US Navy recently completed the UUV Master Plan, a study of the broader scope of AUV applications. The study, which looks ahead 50 years, provides a roadmap for the Navy to use in integrating Unmanned Undersea Vehicles (UUVs) into the battlespace of the future. Critical missions include: intelligence, surveillance, reconnaissance, mine countermeasures, tactical oceanography, communications, navigation, and anti-submarine warfare.

Scientific

International academic and research organisations are pushing the technology toward useful realisation faster than the slow paced introduction into the oil patch or the bureaucratically sluggish military establishment. Because of limited resources and the necessity to launch from small boats or platforms, the academic community has kept vehicles small and economical. Smaller vehicles such as the Woods Hole Oceanographic Institution's (WHOI's) REMUS, MIT's Odyssey, and Florida Atlantic University's new modular AUV Morpheus are showing that cost effective missions can be performed. Small, inexpensive, mass produced AUVs that one can afford to occasionally lose will be the catalyst that pushes operational AUVs from the tens into the hundreds or thousands.

Who's Leading the Pack?

Offshore Survey - Now Operating

The leaders will begin to clarify as more operational data is acquired; however, the Maridan and Hugin vehicles would certainly appear to be the first out of the gate.

The AUVs developed by Maridan A/S, Denmark, Figure 1, have had many recent successes. One of the first was an underwater archaeology survey for the National Museum of Denmark using the Maridan 150 which located and mapped a sunken 12th century ship. In 1999, the Maridan 200 AUV carried out an autonomous survey off the cost of Namibia for De Beers Marine. More recently, the M600, Maridan's first commercially sold AUV, will be used for high-resolution diamond mining surveys by De Beers Marine.

Norway's Hugin AUV was developed and operated by Kongsberg Simrad in partnership with Statoil, the Forsvarets Forskningsinstitutt (FFI - the Norwegian defence establishment) and Norwegian Underwater Intervention (NUI). The Hugin vehicle is in routine use by NUI. In February 2001, the Hugin 3000 AUV, Figure 2, completed acceptance trials by the new owner, C&C Technologies, Inc of Lafayette, Louisiana, and is now operating in the Gulf. BP has committed to at least 100 days of commercial operation using the Hugin 3000.

Hugin 3000 AUV during retrieval

In Japan, the Aqua Explorer line of AUVs has been under development by KDD R&D Laboratories. Their latest version, the Aqua Explorer 2 (AE2), Figure 3, which recently completed a survey of a buried cable in the Taiwan Strait, is now available for hire in the UK through an agreement between Kokusai Marine Engineering Corp. (K-Marine) and Oceanscan Ltd.

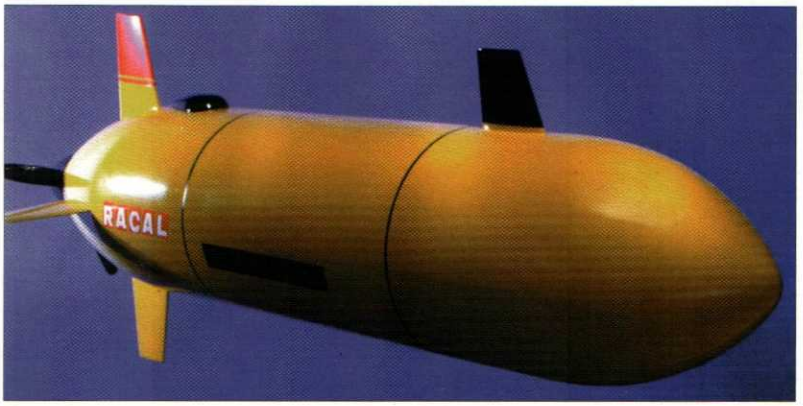
Offshore Survey - in the Queue

The previous three vehicles (or at least their predecessors) are out there working with quoted day rates or sales prices. But what other contenders are lining up?

Thales Survey's (formerly Racal Survey Group Ltd) Sea Oracle, Figure 4, is the next AUV intended to go into the commercial survey market. A team of Racal and Bluefin Robotics engineers is developing the Sea Oracle, which is based on the Odyssey vehicle, a real workhorse in the academic sector. Thales Survey has agreed to purchase two Sea Oracles with an option for a further six.

International Submarine Engineering (ISE) Ltd, Port Coquitlam, BC, Canada, developers of such AUVs as the Theseus and ARCS, has announced plans to develop a hybrid AUV/ROV for offshore applications. ISE will team with Mentor Subsea Technology Services, a unit of J. Ray McDermott, SA to develop the prototype unmanned semi-submersible vessel that will deploy a remotely-operated vehicle. The system, called SAILARS, Figure 5, will be able to cost effectively accomplish a variety of subsea intervention tasks.

In another recent development, the Boeing Company, Fugro GeoServices, Inc and Oceaneering International, Inc has announced a partnership to provide advanced underwater survey services. The venture combines Oceaneering's and Fugro's marine experience and Boeing's unmanned



Thales Survey's Sea Oracle

vehicle and autonomous guidance technologies. The new 18.5 ft long AUV, with a 10,000-foot depth capability, will target the oil and gas exploration and telecommunications markets. Completion of sea trials is expected by the end of this year.

Other Commercial Players

There are also other vehicles that have been developed and delivered commercially. These vehicles cover size ranges from 3 to 30 feet long. On the larger scale, ISE has the Theseus, which deployed a fibre-optic cable under the ice pack, and Perry Technologies has the MUST.

Mid-size vehicles include those from the Institute of Marine Technology Problems (IMTP), Russia, such as the CR-01 and CR-01A, developed in conjunction with the Shenyang Institute of Automation (SIA) and the Chinese Academy of Science, and the OKPO AUV for Daewoo Heavy Industry, Korea.

Smaller vehicles include the CETUS II, developed by the MIT AUV lab for Lockheed Martin, and the REMUS, which was built by WHOI under ONR and NOAA funding.

Non-commercial Scientific

There is also a wide spectrum of operational AUVs whose existence are not driven by the bottom line. These vehicles, which are used for scientific missions, are amassing impressive track records.

The leader in this area appears to be the Southampton Oceanography Centreís Autosub, which continues to complete successful science missions under the funding of the UK's Natural Environment Research Council. In the US, WHOI's ABE vehicle has acquired impressive data and is also going into the ABE II phase. Florida Atlantic University has the Ocean Voyager II, Ocean Explorer and their new Morpheus vehicles.

JAMSTEC of Japan has unveiled their 9.7-metre long, 3,500-metre depth AUV the Urashima. This vehicle will join JAMSTEC's UROV 7K AUV/ROV and their Marine Robot MR-X1 that is under development. The University of Tokyo continues to conduct research with their R-1 Robot and has plans to dive on an erupting underwater volcano in the near future.

The Future

AUVs are now at an early stage of acceptance. As they reach the phase of operational acceptance on a commercial level, their numbers will grow. Academia is not only using AUVs but also spinning off firms to supply commercial versions. And the US Navy is gearing up to push the technology, ensuring that cost-effective systems are available for use by the fleet in the future.

Aqua Explorer 2

But the future will hold more than the acceptance of the 'standard' AUV: it will begin to see the Hybrid AUV/ROV emerge. Today, the number of all electric ROVs, such as the Quest ROV developed by ALSTOM Schilling Robotics, is increasing. These more efficient vehicles will increase system reliability and eventually provide cost-effective components that will become available for use by AUVs. And with this will come the fusion of the AUV and the ROV into the Hybrid AUV that is projected by many to be the future vehicle in the offshore oil and gas industry.

The previous information leads to one definite conclusion: the 'inner space race' has begun and the leaders of the pack are fighting to see who will be there to capture first prize in the future billion-dollar AUV market.

Biography

Robert L. Wernli received his BSc in Mechanical Engineering from UC Santa Barbara and his MSc in Engineering Design from San Diego State University in 1973 and 1985, respectively. He is a programme manager for the Ocean Systems Division of the Space and Naval Warfare Systems Center, San Diego, California, US, where he has worked in the area of undersea vehicles and work systems since 1973. He is a fellow of the Marine Technology Society and a member of the IEEE Oceanic Engineering Society and the American Society of Mechanical Engineers. ■