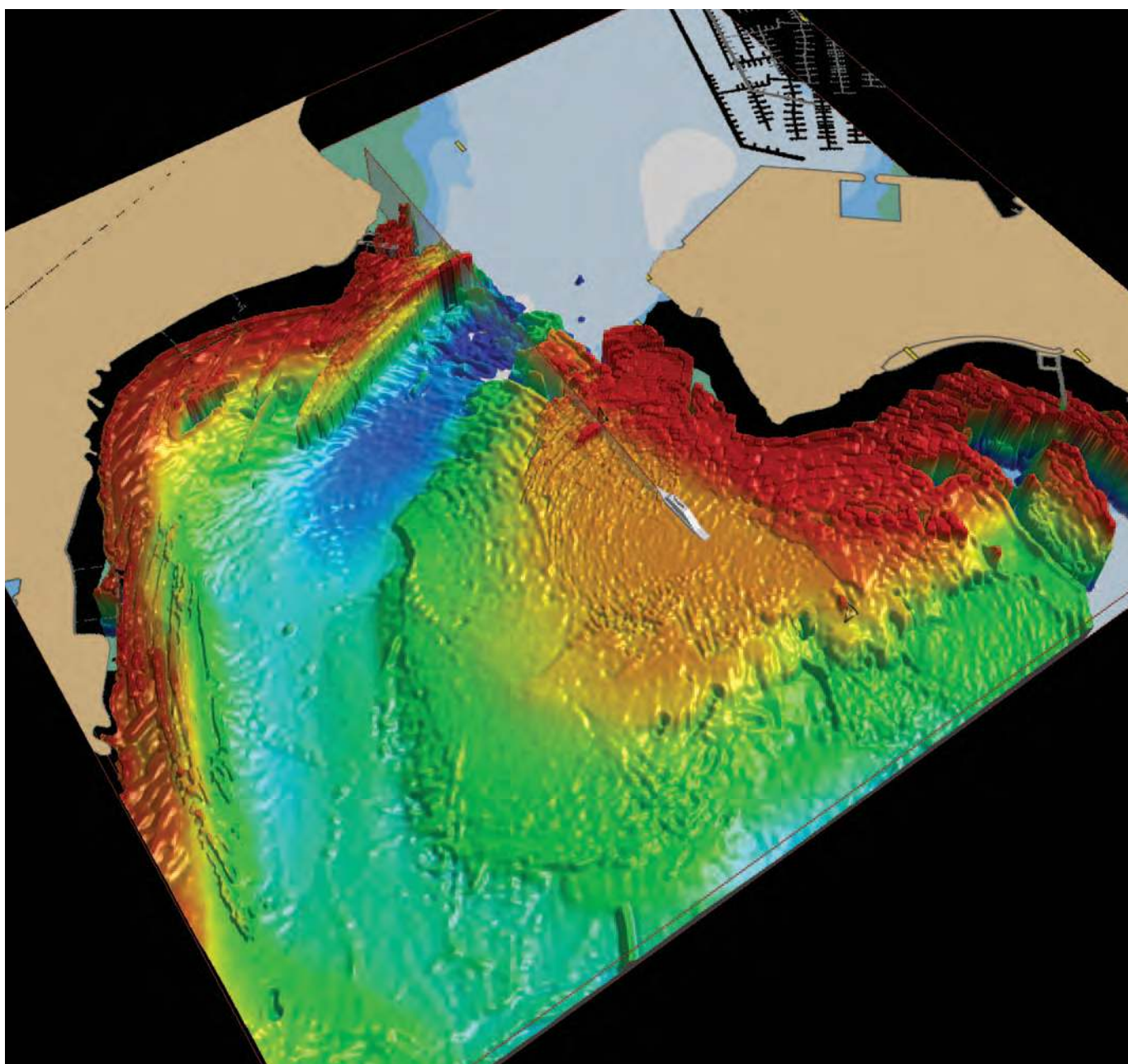


FOREWARNED. FOREARMED

US\$1 BILLION COST TO INDUSTRY. 100 REPORTED ICE COLLISION INCIDENTS A YEAR IN THE BALTIC SEA. 700 CONTAINERS LOST OVERBOARD EVERY YEAR. VESSELS STRIKING AND OFTEN FATALLY INJURING WHALES. AN AVERAGE 42 COLLISIONS AND 37 GROUNDINGS A YEAR. THE STATISTICS ARE A STARK REMINDER OF THE RISKS COMMERCIAL, PRIVATE AND NAVAL SHIPS FACE AT SEA. BUT, HELP IS AT HAND IN THE COMPACT SHAPE OF OUR VIGILANT FORWARD LOOKING SONAR.



SONAR MODE

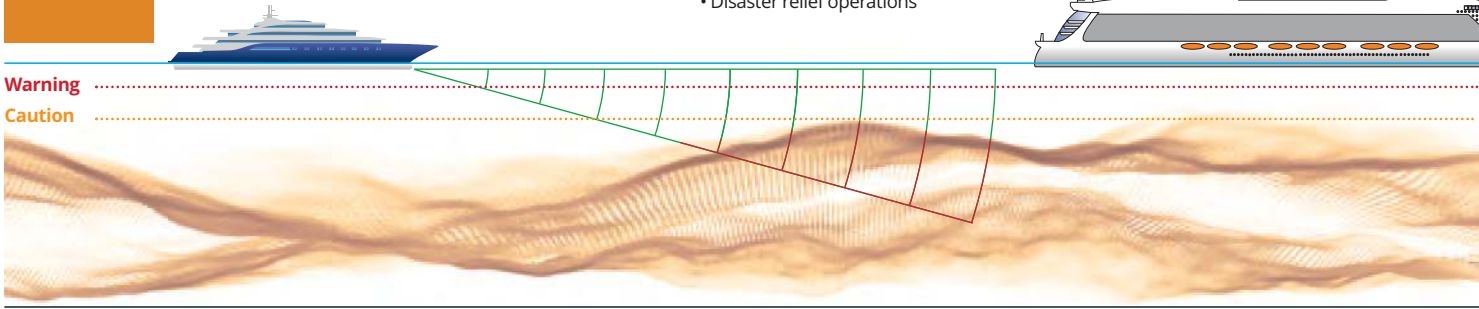
| | |
|---------------|---------|
| Maximum Range | 1,500 m |
| Depth | 100 m |
| Azimuth | 90° |

Grounding Avoidance

- Navigating uncharted waters
- Grounding avoidance in changing environments
- Disaster relief operations

Warning

Caution



Imagine you had the equivalent of a parking sensor installed on the bow of your vessel, just beneath the water line. Imagine that it gave you a live 3D view of the seabed and the water column on your vessel heading. Imagine if that sensor also sent you automated warnings, when something in the water column ahead – hidden from sight, radar or Lidar – presents an obstacle or hazard (the equivalent of a pedestrian or bollard near your car).

We think that would be a powerful tool, de-risking day-to-day as well as the more “off-chart” navigation by the adventurous mariners among us. It would also enable more marine autonomy, providing unmanned craft, surface and sub-surface, with that additional level of situational awareness.

That’s why we’ve built Vigilant, our new long-range, forward looking sonar (FLS). Vigilant FLS is a navigation and obstacle avoidance sonar, built from the ground up based on our previous experience in FLS systems. It provides automated alarms of objects in the water column out to 1.5 km. It also creates – with unrivalled resolution and detail – a real-time, easy to interpret 3D terrain map of the seabed ahead out to 600 m and down to 100 m water depth.

Vigilant is so good you can literally ‘park’ your vessel with it. Just view your crystal clear terrain data for that ideal anchorage. And, at just 31 cm-wide – comparative with a gaming console – and weighing only 14 kg in air (more than 90% lighter than our previous system), it’s easy to handle and install on a wide range of vessels, from private yachts and harbour patrol vessels to offshore support vessels and research ships. It’s also autonomy ready, coming with a specific mode for use with auto-pilot systems.

“It’s an ideal solution for those with an adventurous streak,” says Rob Crook, Research Director at sister company Wavefront Systems Ltd., who have led the development of Vigilant. “You can fit it to your superyacht or expedition cruise vessel and you’re then prepared for anything, from seeking out a secluded bay or voyaging into the Article Circle to watch the Northern Lights. With our sonar on board, these vessels can navigate through unknown reefs, rocks, icy polar regions or shallow sand bars with confidence. You can even use it to examine the seabed topography ahead in order to pick the best anchorage.”

AN ESSENTIAL BRIDGE TOOL

It’s also ideal for those working in busy coastal waters, says Pete Tomlinson, Engineering Manager at Sonardyne. “Coastal shipping is,

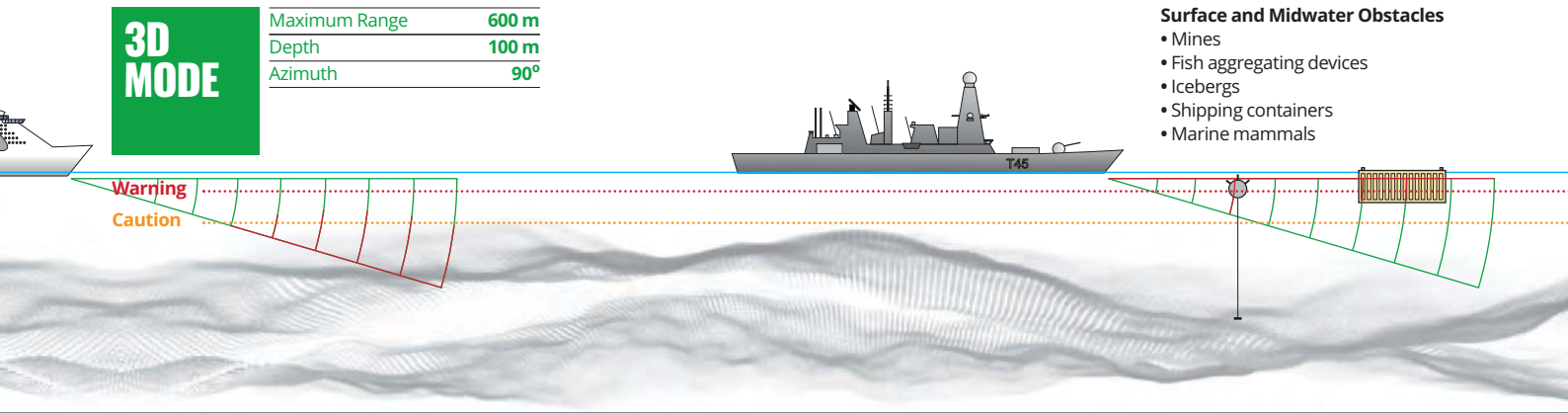
in fact, where the majority of known marine incidents happen. Groundings are all too common,” he says. “These – and costly recovery operations – can be avoided with Vigilant’s automated alarms. Timely alerts mean crew have time to take avoiding action. Offshore energy and commercial fishing operations, which often take place in busy and frequently shallow waters, would benefit too. As would vessels called upon for disaster relief operations, where they can be going in literally blind following a tsunami, earthquake or hurricane that have dramatically changed what may have previously been well charted seabed. With Vigilant, you can see the seafloor. It’s no longer unknown. Even large marine mammals, like whales, can be picked up by Vigilant’s computer aided detection (CAD) markers, which trigger alarms. Regrettably, whale strike happens more than you might think and can result in quite hefty fines and reputation damage.

“For naval operations, with Vigilant, operatives can be prepared for the unexpected, whether they’re in a swimmer delivery vehicle (SDV), or on a coastal patrol vessel or cruiser. With its history mapping capability, which lets you see your past track, they’ve also got great situational awareness for tight manoeuvres or backing out of a confined area. Vigilant FLS remembers where it’s been and what it’s seen! Combined with our Sentinel intruder detection system, naval facilities and assets at anchor or in port can also protect themselves from underwater threats, including closed and open circuit divers and even man-portable unmanned and autonomous underwater vehicles. That’s a powerful combined package.”

COMPACT HARDWARE, COMPREHENSIVE COVERAGE

Vigilant really packs a punch in a compact package because a lot of focused work has gone into its design, of both the hardware and how the sonar works. It’s effectively been designed from the ground up, moving the processing power to the topside and redesigning the sonar array. This has enabled the dramatic reduction in size and means it’s easier to fit, not just in new builds, where it’s relatively easy to design in a hull-mounted sensor, but also retrofits. In fact, our mechanical design teams have developed a novel cassette arrangement that any shipyard can install in the bow during a routine dry dock stopover.

Even more effort has gone into the acoustics involved in Vigilant. It works by transmitting acoustic energy into the water, through a 90 degree azimuth and through a vertical plane down to 100 m water depth – deeper than any other system in the market. It then listens for the sonar returns. These are then used to build an outstanding quality,



real-time 3D bathymetry map of the seafloor and enable the CAD detections out to 1.5 km. Sounds simple?

THE SCIENCE OF SEEING SUBSEA

“Our new FLS probably represents the toughest design challenge Wavefront has ever faced,” says Crook. “Multi-beam echo sounders (MBES) are a common type of sonar which seek to map the water column and seabed topography with a fan of beams projected directly beneath the host platform. In terms of the nature of the resulting imagery – maps of the seafloor and water column objects – this seems rather similar to what we have designed Vigilant to deliver. However, whereas MBES has the luxury of mapping directly beneath the host platform, achieving the fundamental operational requirement of an FLS means delivering the same type of information many hundreds of metres ahead of the host platform, often in shallow water. We need to ‘forward look’ and still provide navigationally relevant terrain and object detection data. That’s not easy.

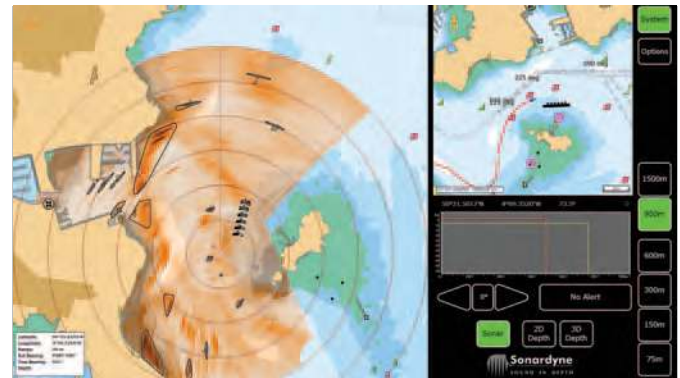
“It means imaging both the surface and the seafloor (two highly reflective surfaces) and anything inbetween. It means handling high levels of multipath interference caused by multiple reflections off these two interfaces. We have to deal with increased levels of ray-bending, associated with propagation through a predominantly horizontal sound channel. We also need to process and select for real-time display a single meaningful cut through of the dense 3D data point cloud of returns. Finally, the imagery has to be electronically stabilised against significant platform motion. With Vigilant, we’ve overcome these challenges and built the most capable (longest range, highest area coverage, highest resolution), commercially available forward looking sonar on the market.”

Vigilant has two principal operating modes, 3D mode and Sonar mode. 3D mode produces stunning 3D bathymetry and colour coded depth imagery using our proprietary Altitude Confidence Filter (ACF), out to 600 m and down to 100 m. Sonar mode processes the intensity of the acoustic data to extract long-range positional data out to 1.5 km and over a 90 degree field of view. In this mode, the sonar returns are used to generate our CAD markers, which alert the operator (or a third-party AI based processor) to the presence of a navigationally relevant obstacle. This could be coral reefs, rocks, containers or even small icebergs.

Both modes use a combination of physical array hardware and a suite of proprietary signal and data processing algorithms to deliver class leading performance.



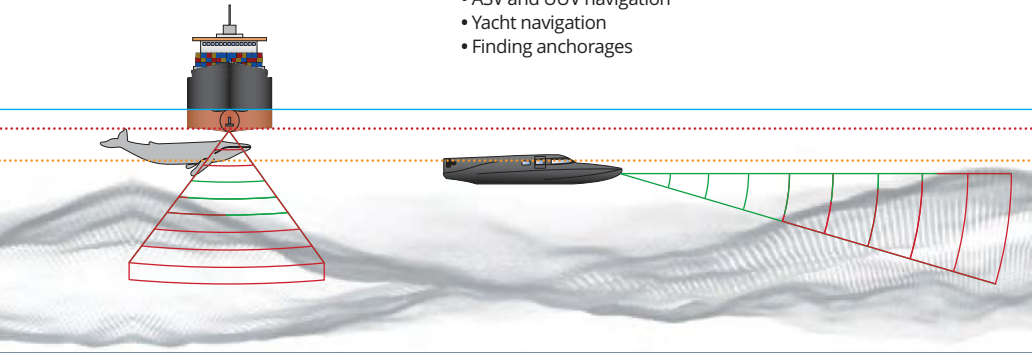
“Vigilant really packs a punch in a compact package because a lot of focused work has gone into its design, of both the hardware and how the sonar works. It’s effectively been designed from the ground up.”



The long view: In Sonar mode, Vigilant provides an unparalleled 1.5 km warning system, giving mariners plenty of time to react to dangers in the water ahead.

Operating in Tight Spaces

- Swimmer delivery vehicle navigation
- ASV and UUV navigation
- Yacht navigation
- Finding anchorages



ROUTE GUIDANCE MADE EASY

Under the hood, it's not simple. But, you don't have to be a sonar expert to use Vigilant. We've focused heavily on making the graphical user interface (GUI) easy to use with automatic obstacle detection and classification. In Sonar mode, Vigilant has CAD markers showing potential obstacles, including objects like ISO shipping containers or small icebergs, as well as shallow seabed, which provide the mariner with timely, clear and easy to see warnings. That gives you more time to act. Vigilant even picks out hard objects in sandy or silty seafloor environments. A warning at 300 m, a typical range of other less capable systems, just doesn't give the vessel's crew enough time to respond.

If required, you can also view the raw profile data showing the entire water column, so you can see how deep an object is. If it's something shallow, for example, divers in an SDV could use Vigilant to see that they are able to pass underneath it.

RESULTS, WHEN YOU NEED THEM

During our rigorous testing throughout last year, we've been putting these capabilities to the test and even we're impressed. In really rough and pretty hostile acoustic conditions, in terms of salinity and temperature variations, it's been performing. During one trial, our vessel was pitching so much that every now and again the frame-mounted sonar actually came out of the water. Yet, it was still seeing things in Sonar mode in these conditions – which it wouldn't have to contend with on a large ship deployment. It's easily picking out marker buoys, more than 1 km away, in Sonar mode. That's impressive. In 3D mode, it even produces fantastic images in quite enclosed harbours; a space that's about as challenging as you can get for sonar.

Vigilant is now in production and we're already working with customers keen to see what it offers. So, if your vessel is still on the drawing board or scheduled for a dry dock this year – wherever that might be – now's a great time to speak to us about your requirements. We have 3D hardware models and data sets we can share with you and are planning several in-water demos in Europe and the Far East to showcase what it can do. Get in touch to find out more, read on to find out how SubSea Craft plans to use its Vigilant. [RL](#)

INTRODUCING THE VICTA DIVER DELIVERY UNIT

Gaining an advantage in an increasingly complex maritime security arena is a major challenge. With the advent of evermore sophisticated technologies proliferating in coastal waters, naval commanders at all levels are stretched as they seek options to maintain hard-won superiority.

Stealth, speed and reliable situational awareness both on and below the surface are vital components of comprehensive operational capability and our Vigilant forward looking sonar (FLS) is providing just that to a revolutionary new diver delivery unit (DDU), developed by UK maritime technology company, SubSea Craft.

TACTICAL ADVANTAGE

Combining cutting-edge hull design, composite material construction and an advanced control system, the company's VICTA class DDU offers the speed and endurance of a long-range insertion craft (LRIC) with the stealth and capacity of a swimmer delivery vehicle (SDV). The team behind it has extensive operational experience and the result is a first-of-kind, fly-by-wire craft that can rapidly transition from surface to sub-

surface configuration. VICTA can travel up to 250 nautical miles (nm) at speeds of up to 40 knots on the surface, to swiftly deliver up to eight operatives (two crew and six divers) to their objective area mission-ready. Below the surface, it cruises at 6 knots, with a 'sprint' capability of 8 knots, for up to 25 nm.

It's also easy to transport and deploy into a theatre of operation. At just under 12 m long, it fits comfortably into a standard shipping container and can be deployed from an unmodified surface vessel or port of opportunity. It can even be carried underslung from a heavy-lift support helicopter, such as the CH-47 Chinook.

GOING IN FOREWARNED

But, it's when VICTA is on and beneath the surface that Vigilant plays its enabling role. Being able to detect – at range – navigation hazards, before they become a real threat, is mission-critical to the sort of operations likely to feature in VICTA's play-book. Vigilant is the solution.

VICTA in numbers



| | |
|---------------------------|---------------------|
| Length | 11.95 m |
| Beam | 2.3 m |
| Draught | 0.06 m |
| Crew | 2 |
| Divers | 6 |
| Fully loaded displacement | 9,315 Kg |
| Surface cruising speed | 30 kts |
| Surface top speed | 40 kts |
| Endurance | 250 nm (expandable) |
| Dive depth | 30 m |
| Subsurface cruising speed | 6 kts |
| Subsurface sprint speed | 8 kts |
| Subsurface range | 25 nm |

With Vigilant integrated into VICTA, complete with its easy to use, intuitive graphic user interface, pilots can visualise the environment ahead to navigate safely and avoid obstacles ensuring safe insertion and recovery of operators, regardless of the mission. Quite simply, it provides a tactical advantage for their operations.

Using sophisticated bow-mounted transducers, Vigilant displays water depth, sub-surface obstacles and features by creating an accurate 3D model of the underwater environment over a 90° field of view. The model is displayed relative to the vessel, overlaid on standard charts in real-time, providing operators with an easily-interpreted topographical image of their navigation track. It may also enable intruder detection, potentially vital in high-risk, high-threat environments.

UNIQUE VISUALISATION

“Vigilant allows us safe and unhindered surface/sub-surface manoeuvring,” says Tim



Chicken, SubSea Craft's Chief Commercial Officer. "Vigilant was selected because of a proven track-record and a compatibility with our proposed concept of operations allowing VICTA to operate safely in confined water-space owing to its unique 2D and 3D visualisation capability."

For example, pilots can use 2D, for obstacle avoidance, and 3D, for a real-time, three-dimensional view of the world around them, allowing navigation within potentially hazardous coastal – or what are known as littoral – zones where hidden threats, man-made or natural, may be lurking.

Combing all of these unique capabilities, VICTA broadens the options open to maritime, joint and special forces commanders, providing an advantage previously not available with conventional craft. It's a powerful capability able to support operational requirements ranging from advanced force insertion through to maritime counter-terrorism and constabulary operations; for all of which, situational awareness is key.

UNRIVALLED PERFORMANCE

"One of Vigilant's main advantages is its range," says Ioseba Tena, our Global Business Manager for Robotics and Defence. "It can see out to 1,500 m, in 2D mode, and then to 600 m in 3D mode, to help you plot your environment in real-time ahead of the vehicle. Performance that is unrivalled."

SubSea Craft worked in close partnership with a number of other cutting-edge marine technology and engineering businesses, including Ben Ainslie Racing Technologies and control systems specialist SCISYS. It was built by AC Marine and Composites Ltd. Why not go to our YouTube channel to watch Subsea Craft's Bill Barfoot talking about Vigilant and VICTA's capabilities at last year's DSEI London, where the craft was first revealed? [▶](#)

Find out more at www.subseacraft.com



Watch for yourself Bill Barfoot introducing the Victa DDU at DSEI.

Previous page: Vigilant is easy to interface with third-party control systems such as SCISYS. Left: SubSea Craft's VICTA class diver delivery unit (DDU) combines cutting-edge hull design, composite material construction and an advanced control system. Right: With our Vigilant FLS onboard, operatives gain a tactical advantage, being able to see where they can navigate, including under obstacles and in confined spaces, as well as being able to easily view their past track for easy extraction.



THE KIT LIST

WHAT'S FEATURED IN THIS STORY

Vigilant FLS



What is it?

Vigilant FLS is a long-range, forward-looking sonar for ships, unmanned surface platforms and crewed underwater vehicles. With the ability to detect uncharted navigation hazards and submerged obstacles as far away as 1,500 m, Vigilant FLS means crews have time to safely manoeuvre their vessel or vehicle around the hidden danger.

How does it work?

Vigilant's compact, bow-mounted sonar array scans the water column and builds up a highly detailed and accurate model of the seabed and submerged objects ahead of the vessel.

The intuitive display informs the crew of the seabed terrain and any potential underwater hazards up to a range of 600 m over a 90° field of view in 2D mode and 3D depth modes and out to 1,500 m.

How will it benefit your operation?

Vigilant improves underwater situational awareness for commercial, military, cruise and private yachts by reducing the risk of underwater collisions and groundings when operating in uncharted and unfamiliar waters

Its small form factor makes it suitable for both new-build installation and retro fits in existing vessels. It can be integrated with existing bridge systems and has an optional intruder detection security capability when at anchor.