INTERNATIONAL SECTION 2021

FarSounder

Giving vessels an underwater eye ahead

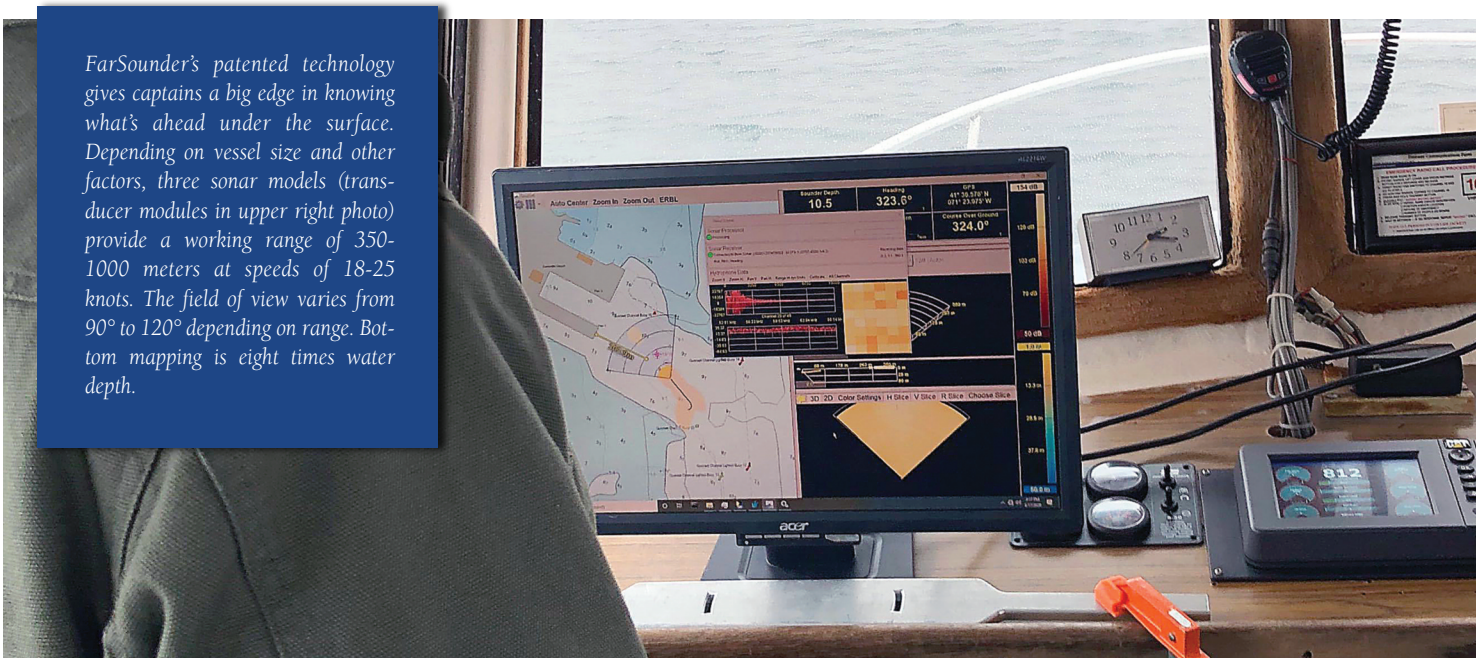
In the late 1990s, electrical engineering student Matthew Zimmerman and James H. Miller, his professor of Ocean Engineering at the University of Rhode Island, had an idea for an improved sonar system that could look ahead of a vessel and warn of subsea obstructions, like the rocks that punctured the hulls of the Exxon Valdez and QE II. They officially began work on their forward-looking sonar in 2001 and launched the first product, the FS-3 Navigation & Obstacle Avoidance System, three years later. Since then FarSounder has received several patents for their 3D forward-looking technology.

BY DEAN TRAVIS CLARKE

Zimmerman may have inherited his interest in engineering from his mother, Cheryl, a mechanical engineer with a Master's degree in thermodynamics and fluid mechanics. She saw the potential of the forward-looking sonar project and convinced them it was a viable business opportunity. Cheryl worked with her son and Miller to help create FarSounder and to mature the technology. "Almost exactly a year later I left my own engineering job and company to help get the technology out of the lab and commercialize [FarSounder's] products," she said. "The rest is history." Cheryl is now CEO of the Warwick, RI-based company, Matthew is Executive Vice President, and Miller, still on the URI faculty, is a member of the Board of Directors.

FarSounder runs a lean operation with typically about a dozen employees plus a few interns. It has an extensive network of dealers around the world offering sales and service. When asked about sales volume, she said, "As a private company the details are proprietary. I can share that we are a profitable C-corporation." Not much detail but profitable is good.

The company's initial strategy required a sonar system that offered a wide, panoramic view and longer range than any similar type of product. At the same time, for maximum market penetration the product also had to be of



FarSounder's patented technology gives captains a big edge in knowing what's ahead under the surface. Depending on vessel size and other factors, three sonar models (transducer modules in upper right photo) provide a working range of 350-1000 meters at speeds of 18-25 knots. The field of view varies from 90° to 120° depending on range. Bottom mapping is eight times water depth.

both a practical size and price range. Additionally, all system components had to be sourced in America.

Product lineup

FarSounder sonars have commercial, military and recreational applications with cruise ships, passenger vessels and research vessels representing the lion's share. Client vessels range from less than 60 feet to longer than 1,200 feet, and FarSounder and their sonars have earned "trusted node" status for NOAA crowd-sourced bathymetry. Their products also help unmanned autonomous vessels navigate in many parts of the world. Zimmerman noted that their superyacht segment is growing quickly, thanks especially to the recent proliferation of long-range explorer yachts that travel to remote, often inhospitable locations such as Antarctica and Greenland.

The current product roster includes three models offering different operational ranges and speeds: Argos 350, Argos 500 and Argos 1000. FarSounder says the "systems are the only products on the market capable of generating a true, 3-dimensional image ahead of a vessel in real-time." The Argos 350 was not launched until the Covid pandemic eased and is still in a market launch position. Presently, sales run approximately 50/50 between the Argos 500 and the Argos 1000 models, and about 50/50 between newbuild and refit installations.

The technology

FarSounder utilizes phased-array transducers to present a high-resolution 3-dimensional image from every individual ping. "All of our sonars employ separate transmitter and receiver arrays," said the CEO. "On transmit, each ping ensonifies the entire volume of interest (i.e. up to +/- 60 degrees off each side of the bow, up about 10 degrees to the sea surface, and down about 50 degrees to the sea floor). On receive, the echoes from the transmitted ping are received by an array of receivers which have directivity in both the vertical and horizontal directions. This means that our sonars listen to thousands of angles simultaneously and extract a true 3D image from the dense set of 3D sonar returns—with a single ping." So, unlike sonars that piece together numerous returns for a single picture, the FarSounder signal produces full volume and data with each ping.

The industry calls the yardstick for rating forward-looking sonar SCOPE. This measures the ratio between depth below the keel and the effective range looking forward. For example, operating on 61 kHz, the Argos 350 claims a scope of eight times water depth looking forward and a beamwidth of 90 degrees out to 350 meters at a maximum speed of 18 knots. The 500 model claims the same scope with beamwidths of 120 degrees up to 200 meters and 90 degrees up to 500 meters range with a maximum speed of 20 knots. The 1000 model boasts a top speed of 25 knots with the same beamwidths as the others plus 60 degrees up to its rated 1000-meter range. Bathymetry below the keel (straight down) can't be detected to the system's farthest ranges. By comparison, the company's first product, the FS-3, had a maximum range of 330 meters, a 90-degree field of view, and a refresh rate of two seconds.

All Argos models tout a maximum power output of 1,500 RMS and operate on Windows version 10. While the Argos 350 carries a relatively modest MSRP of $55,000, the 500 and 1000 units jump dramatically to $103,000 and $178,000 respectively.

Avoiding whale strikes

Comparing FarSounder's 61 kHz broadcast frequency to other systems, we thought the choice unusual. Zimmerman had a surprising answer. She said they had no core technology requirements demanding that specific frequency, but that they had multiple reasons for choosing it.

"Our original motivation stems from reducing the environmental impact of operating vessels. The North Atlantic right whales live in our region, and one of their leading causes of death is being hit by ships and boats. We were motivated to develop a technology that could help avoid whale ship strikes. So obviously we wanted to develop a product that would be benign to the marine environment we were interested in protecting. 61 kHz is out of the hearing range of the great whales and a higher frequency than the commonly accepted 50 kHz used in vast amounts of echosounders."

Performance also enters into the equation, however. "We need to balance our needs between signal propagation, resolution, and physical size. So, we need a good amount of SNR (Signal to Noise Ratio). This means staying away from 50 kHz directly and operating near the minima of natural environmental noise." The company continues to explore other frequency ranges for specialized applications.

Executive VP Matthew Zimmerman and a URI professor came up with their forward-looking sonar concept while he was a student. His mother, Cheryl, a mechanical engineer, came aboard to help create the company and further develop the technology. She is now CEO.

As for installation, FarSounder sonars are generally secured in a fixed fairing that doesn't require any moving parts. However, the Argos 350 is designed to be installed in a fixed fairing or with a hoist, depending upon the user's preference. Hoist installation sizes vary according to vessel. The Argos 350 can fit into a standard 10-inch-diameter sea chest. The Argos 500 and the Argos 1000 have no standard hoist configuration. Those installations depend on hull design and what, if any, ice class the hulls are designed to meet.

Applications

Commercial shipping, cruise ships and the military have incorporated FarSounder into their electronics suites, as have a growing number of large private yachts. In addition to an unspecified number of superyachts, the roster includes a new 410-foot polar research vessel operated by the British Antarctic Survey, a 286-foot ocean exploration vessel, a fleet of luxury boutique cruise ships, and the largest recre-

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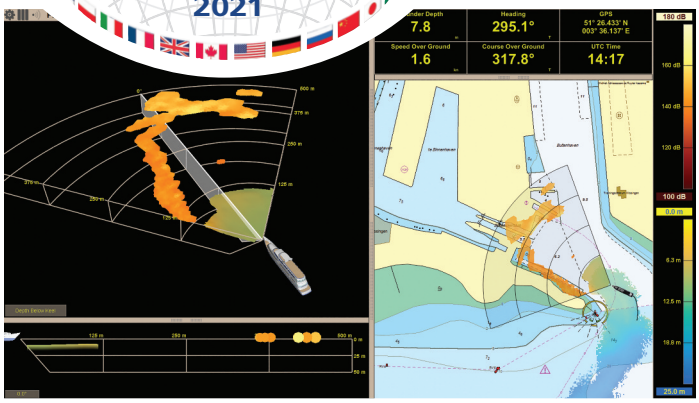

The company developed a software kit that enables marine electronics manufacturers to integrate FarSounder's products into their integrated bridge systems. A duplex communication protocol allows ECDIS makers to layer sonar displays over charts, similar to radar overlays.

ational motor yacht ever built in Canada, a 164-footer that is currently under construction.

Surprisingly perhaps, tugs, push boats and river barges haven't adopted this technology as enthusiastically as one might anticipate. Seems like a forward-looking sonar on a lead barge navigating a river would be a real time and money saver. Muddy water and currents reportedly have no negative impact on FarSounder's performance. Aerated water, however, reportedly does pose problems, just as it does with other transducers.

Mid-size autonomous surface vessels (ASVs) are at a high risk of collision due to the absence of an onboard watchstander combined with the limitations of traditional navigation equipment. FarSounder recommends its Argos 500 system for ASVs that require a range of 500 meters for collision avoidance and mission data collection. ASV owners want to have access to every tool available to keep their investment safe. For speeds up to 20 knots, this system will reportedly give the vessel the information it needs to avoid danger via machine interface so that the team back at home base can feel confident the vessel will safely achieve its mission.

Transducer installation can be with a traditional hoist or mounted in the bulbous bow, either in front or to the side. Belowdecks equipment is self-contained and labeled to facilitate shipyard installs. Like all sonar transducers, placement to avoid turbulence is critical.

FarSounder created a Software Developer Kit (SDK) that enables marine electronics makers to integrate the sonar manufacturer's products into their own Integrated Bridge Systems (IBS). It is a duplex communication protocol that protects each company's unique IP, allowing ECDIS (Electronic Chart Display and Information System) manufacturers to layer FarSounder's sonar display over charts much like a radar and satellite. Without getting into the proprietary nitty-gritty, FarSounder integrates with any other company's ECDIS via a connection to standard SonaSoft software running as a standalone server. FarSounder's software then integrates to other clients' systems via a standard Ethernet connection.

The industry's quest to develop effective and reliable forward-looking sonar goes back many years. Companies such as Interphase, Apelco and American Pioneer made a run at the technology but had no long-term success. In 2007, Sperry was the first to integrate FarSounder's sonar, followed shortly thereafter by Transas. Today, FarSounder lists Wartsila NACOS Platinum combination of control systems for navigation and other functions and QPS Qinsy for survey applications among its user base. FarSounder has dealers in 38 countries outside the US.

Other forward-looking sonars

Perhaps the most common question people ask is how the Argos technology differs from other forward-looking sonar products. Only one other manufacturer, Daniamant, directly competes with FarSounder in the commercial and military markets. Their EchoPilot FLS 3D consists of two separate computers, one of which processes data provided by the transducer to create a 3D display image. Its display beamwidth is 60 degrees and operates on a 200-kHz signal. The FLS 3D has a 100-meter depth range and a forward distance top end of 200 meters.

Several other companies, including Garmin and the three Navico brands offer forward-scanning sonars that target the sport fishing market. Garmin's Panoptix Premium FrontVü forward-looking sonar operates at 417 kHz and features an operating maximum range of 100 feet and depths to 300 feet. Maximum vessel speed for best performance is eight knots. The 180-kHz ForwardScan sonars branded by Simrad, Lowrance and B&G offer nominal 2D forward views of four-to-five times water depth and maximum forward range of eight times depth.

Simple installs

Dr. Glenn Wright is CEO of GMATEK, Inc. in Annapolis, MD, a FarSounder customer that focuses mainly on commercial shipping, military and autonomous vessels rather than yachts. "The installation is quite straightforward," he said. "The tube installation is simple for the shipyard to install. The belowdecks equipment is all self-contained and clearly labeled to make terminations easy."

Asked to compare installation to other standard down-looking sonars, Wright said, "Other non-forward-looking sonars require mounting and termination of numerous control boxes which makes space-

finding on some vessels difficult. Also, the transducer cannot be serviced in the water. This requires pulling the vessel out of the water should there be an issue. With FarSounder the sonar unit can be removed while in the water and reinstalled should this be required."

As with any sonar transducer, placement on the hull in the clearest possible water is crucial. Commercial ships most often mount the transducer in the bow bulb. Maintenance can readily be taken care of by a diver. "If the transducer can't be installed in the bow directly, FarSounder has the ability to mount the transducer on the side of the bow with the shipyard making an eyebrow to direct water flow," said Wright. "And calibration is very easy. The directions along with the operator interface that FarSounder provides are very intuitive, making calibration smooth." Another good characteristic, he said, is that FarSounder's system easily interfaces with other onboard electronics.

Wright is currently engaged in a project with FarSounder to provide its technology for a host of autonomous vessels. Looking ahead, he said he'd "like to see the company continue perfecting interfaces as manufacturers come out with new equipment. I would like to see a less expensive model that can compete with other sonar manufacturers catering to the smaller yacht market. I would also like to see training classes increased and possibly have classes in the South Florida area."

Forward-looking sonar has come a very long way since the original recreational products—like the Apelco 560. In fact, comparing those early players to FarSounder and the other advanced systems now available is like comparing the Wright Brothers at Kittyhawk to Elon Musk and SpaceX. With more than 10,000 autonomous vessels operating around the globe and more to come, the company's technology is certain to grow in capability and market reach. **MEJ**

About the author

Capt. Dean Travis Clarke is a lifelong seafarer, author, editor and acknowledged marine industry expert.