New Sonar Developments

28 February 2011

The sinking of the Cheonan highlights the importance of sonar systems for undersea warfare. Chris Lo checks up on some of the biggest and best sonar contracts and technological innovations.

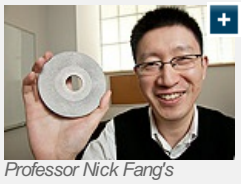
The sinking of South Korean Pohang-class corvette ROKS Cheonan at the end of March 2010, by a suspected torpedo attack from a North Korean submarine put undersea warfare into the headlines. Evidence of the military prioritisation on sonar systems can be seen in the high levels of investment into this technology by the world's navies through last year and into 2011.

The last year has been dotted with major sonar contracts and continuing innovation in this field. From systems that can be used in tandem with complementary applications to higher resolution images through synthetic aperture sonar (SAS), the industry is working hard to bring sonar imaging into clearer focus.

South Korean defence experts, spurred on by the sinking of the Cheonan, have devised a new modelling system for underwater warfare to help inform the strategies behind naval procurement and tactics. This research, completed by experts at the Korea Advanced Institute of Science and Technology (KAIST) and Seowon University, is now focussing on incorporating the complex variables of multiple sonar systems and multi-static acoustics.

This research, alongside similar programmes taking place at universities in countries like the US and UK, could drive sonar procurement and innovation across the world. Here, Naval Technology rounds up some of the most significant sonar developments from the last few months, from landmark contracts and modern innovations to more futuristic technologies, including a new innovation that takes its inspiration from nature's finest sonar systems - dolphins.

Sonar procurement has been high in 2010, and looks to remain that way leading into 2011.



Professor Nick Fang's acoustic cloaking device could threaten the efficacy of modern sonar systems.

The natural sonar abilities of dolphins inspired the development of twin inverted pulse sonar (TWIPS) at Southampton University.

Developments in mine countermeasure sonar

"Synthetic aperture sonar (SAS) allows for much higher resolution images than traditional sonar."

One of the most common modern naval applications of sonar technology is in minehunting operations. Modern mine countermeasure (MCM) sonar systems need to have the capability to locate small objects at a range of depths. Defence electronics company Thales has been highly active in this field; in October 2010, the company's flagship 2093 and 2193 minehunting sonar systems (2093 is a variable depth sonar suitable for deepwater operations while 2193 is hull-mounted and optimised for use in littoral waters) were put to the test on bilateral operations with the Royal Navy and the US Navy in the Arabian Gulf.

Commander David Bence, who leads the Royal Navy's Mine Counter Measures Force and directed the joint operation, praised the two systems' complementary capabilities. "Already proven in more temperate waters around the UK, Thales's 2093 and 2193 sonars have performed exceptionally well in the challenging environmental conditions of the Arabian Gulf," he said. "With capabilities that complement each other, they provided a high probability of detection of sea mines - from shallow to deep water - in highly saline water with high ambient sea temperatures. They are world beaters."

Related Features

Global Defence Technology Issue 9
This month we look at the growth of military power in the Asia-Pacific...

Snapshot France - defence industry to 2015
French involvement in anti-terrorism, modernisation and UN peacekeeping...

From drawing board to launch pad: The rise, fall and rise of the Bulava
The Bulava missile has defied plagued test failures and now finally...

Flying fuel efficient
Keeping a modern air force flying requires an impressive amount of...

Global Defence Technology Issue 8
This month we look into the future of unmanned aircraft...

See all features

In December 2010, BAE Systems landed a $14m contract with the US Navy to upgrade the existing AN/SQQ-32(V)3 sonar systems installed on the navy's MCM-1 Avenger Class mine countermeasure vessels. Designed in conjunction with the Naval Surface Warfare Center Panama City and the University of Texas' Applied Research Laboratory, the new (V)4 system will improve detection performance in shallower waters as well as enhancing detection of stealth mines. "We now have a new customer, a new mission and a new product. We look forward to partnering with the Navy to deliver this improved minehunting capability to the fleet," said BAE's director of persistent surveillance Howie Weinstein.

Synthetic aperture sonar

One of the evolutions of modern sonar is synthetic aperture sonar (SAS), which allows for much higher resolution images than traditional sonar by combining different acoustic pings. In October 2010, Atlas Elektronik UK gave international military and industry organisations, including the Royal Navy's Fleet UUV team, a demonstration of its new Vision600 SAS system, used in conjunction with the SeaOtter MkII autonomous underwater vehicle (AUV).

"Professor Fang and his team have unwittingly issued a challenge to the sonar development industry."

The defence applications of this systems are clear, especially as the demonstration included the recording of sonar data from a dummy minefield. In a statement, Atlas said: "The work, conducted under internal Atlas R&D funding, has generated an excellent survey data set of both civil and military data and imagery which Atlas will now use to further its research into Automatic Target Recognition (ATR). The quality of the imagery is amongst the best seen from an SAS system anywhere in the world with a 25mm resolution in both long and cross track data."

This level of sonar detail is what makes the prospect of including ATR feasible, which could usher in a new wave of advancement for sonar system intelligence.

The sonar killer

Beyond the sonar contracts and demonstrations that are taking place today, scientists across the world are developing new technologies that could have a profound effect on the development of sonar.

The first is a development that threatens to render sonar obsolete. At the University of Illinois in the US, a research team led by mechanical science and engineering Professor Nicholas Fang has developed an acoustic cloaking device that can effectively make objects invisible to sonar.

"Using twinned pairs of sound pulses, TWIPS can potentially enhance the acoustic scatter of a hidden object while minimising clutter."

The cloak, which takes the form of concentric rings of acoustic circuits designed to manipulate sound waves rather than allowing them to be reflected or absorbed, is already being explored for possible military applications such as stealth submarines. "The structure of what you're trying to hide doesn't matter," said Fang. "The effect is similar. After we placed the cloaked structure around the object we wanted to hide, the scattering or shadow effect was greatly reduced."

Professor Fang and his team have unwittingly issued a challenge to the sonar development industry, but it's yet to be seen whether this potential bombshell for sonar will come to fruition.

Dolphin-inspired sonar

Another innovation that is in the very early stages of development is twin inverted pulse sonar (TWIPS). Inspired by dolphins' still-unexplained ability to track prey through bubble clouds that scramble modern sonar systems, researchers at Southampton University in the UK developed TWIPS to penetrate bubbles, which could potentially increase sonar reliability in littoral waters.

Using twinned pairs of sound pulses, TWIPS can potentially enhance the acoustic scatter of a hidden object while minimising the clutter caused by surrounding bubbles. In experiments, TWIPS has outperformed standard sonar when detecting a small steel disc in bubbly water.

In an interview with fishnewseu.com, research lead Professor Timothy Leighton explained the future applications of the technology. "Cold War sonar was developed mainly for use in deep water where bubbles are not much of a problem," he said. "But many of today's applications involve shallow waters. Better detection and classification of targets in bubbly waters are key goals of shallow-water sonar."