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Dolphins inspire a better kind of sonar

Washington: Inspired by the sonar capabilities of dolphins, scientists have developed a new underwater device that can outperform standard sonar and detect objects through bubble clouds.

Taking a cue from nature, Professor Timothy Leighton of the University of Southampton's Institute of Sound and Vibration Research (ISVR) developed a new sonar concept called twin inverted pulse sonar (TWIPS).

TWIPS exploits the way that bubbles pulsate in sound fields, which affects the characteristics of sonar echoes.

"To catch prey, some dolphins make bubble nets in which the best man-made sonar would not work. It occurred to me that either dolphins were blinding their sonar when making such nets, or else they have a better sonar system," Leighton said.

However, because there were no recordings of the type of sonar that dolphins use in bubble nets, Leighton wasn't able to produce a bio-inspired sonar simply by copying dolphin signals. Instead, he sat down and worked out what pulse he would use if he were a dolphin.

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The TWIPS system he and his colleagues devised exploits the way that bubbles pulsate in sound fields. It does this by using twinned pairs of sound pulses. The first pulse of each pair has a waveform that is an inverted replica of that of its twin and is emitted a fraction of a second before its inverted twin.

First, Leighton's team showed theoretically that TWIPS might be able to enhance scatter from the target, while simultaneously suppressing clutter from bubbles. Therefore, in principle, it could be used to distinguish echoes from bubble clouds and objects that would otherwise remain hidden.

The team then used a large test tank to test the concept and found that TWIPS outperformed standard sonar at detecting a small steel disc under bubbly conditions resembling those found under oceanic breaking waves.

Encouraged by their findings, the team then conducted more sea trials. On Southampton Water, a seabed varying in depth between 10 and 20m that handles seven percent of the UK's entire seaborne trade, they compared the ability of TWIPS and standard sonar to discern the seabed.

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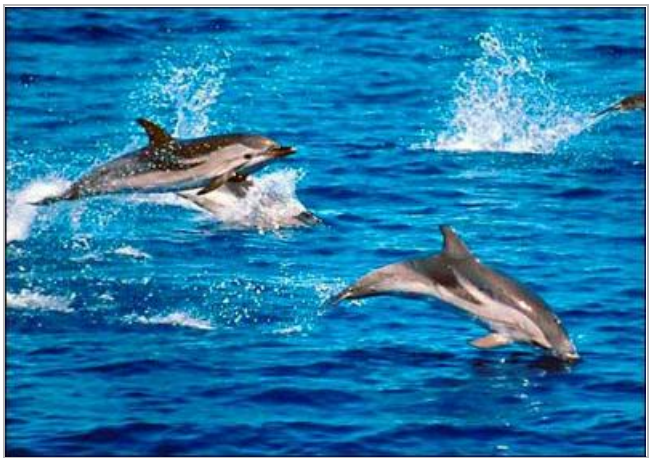

"TWIPS outperformed standard sonar in the wake of large vessels such as passenger ferries," said co-author Dr Justin Dix of the University of Southampton's School of Ocean and Earth Science (SOES).

The team sees possible future marine applications for TWIPS, including harbor protection and the detection of bubbles in marine sediments and manufacturing. They also said technologies based on the same basic principles could be used in the medical field for ultrasound imaging - which already uses pairs of inverted pulses to enhance contrast agents injected into the body - or magnetic resonance imaging (MRI).

Leighton also proposed TWIPR (twin inverted pulse radar) to detect improvised explosive devices or covert circuitry.

Interestingly, even though dolphins were the inspiration for TWIPS, it's still not known whether they actually use such a system.

"Key ingredients of a TWIPS system appear in separate species but they have never been found all together in a single species," said Leighton.

"There is currently no evidence that dolphins use TWIPS processing, although no one has yet taken recordings of the signals from animals hunting with bubble nets in the wild. How they successfully detect prey in bubbly water remains a mystery that we are working to solve," he added.

Source: ANI

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