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Science

New Dolphin-Inspired Sonar Concept "Sees" Through Bubble Clouds

Tiffany Kaiser - November 18, 2010 10:36 AM

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12 comment(s) - last by TeXWille r.. on Nov 19 at 11:29 AM

Twin inverted pulse sonar concept can detect targets through bubble clouds caused by breaking waves

[University of Southampton](#) researchers have created an [underwater sonar device](#) capable of detecting objects through bubble clouds.

Professor Timothy Leighton, study leader from the [University](#) of Southampton's Institute of Sound and Vibration Research (ISVR), and his team, have developed a sonar device that can "see" through bubble clouds through the use of a new sonar concept.



Leighton and a dolphin (Source: noc.ac.uk)



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Standard sonar devices already in use utilize differences between [sound pulses](#) and their echoes to identify objects such as wrecks, reefs, fish and submarines. But when it comes to bubble clouds, which are created mainly from breaking waves, these conventional sonar devices' sound becomes scattered and the sonar image is blurred.

"Cold war sonar was developed mainly for use in deep water where bubbles are not much of a problem, but many of today's applications involve shallow waters," said Leighton. "Better detection and classification of targets in bubbly waters are key goals of shallow-water sonar."

To remedy poor detection in bubbly waters, Leighton and his team created a [new sonar concept](#) called twin inverted pulse sonar (TWIPS). TWIPS dissects the way bubbles pulsate in sound fields, which is an act that influences the characteristics of sonar echoes.

TWIPS' design consists of trains of twinned pairs of sound pulses where the first pulse of each pair has a waveform that is an inverted duplicate of that of its twin. The first pulse is sent exactly a fraction of a second before its inverted duplicate. According to Leighton, this concept was inspired by dolphins.

"To catch prey, some dolphins make [bubble nets](#) in which the best man-made sonar would not [work](#)," said Leighton. "It occurred to me that either dolphins were blinding their sonar when making such nets, or else they have a better sonar system. There were no recordings of the type of sonar that dolphins use in bubble nets, so instead of producing a bio-inspired sonar by copying dolphin signals, I sat down and worked out what pulse I would use if I were a dolphin."

Leighton and his team have tested the TWIPS concept in a large testing tank as well as at sea on the University of Southampton's coastal research vessel, the RV *Bill Conway*. At sea, TWIPS was tested against conventional sonar when challenged to identify the seabed in Southampton Water, which ranges between 10 and 20 meters in depth.

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

Leighton and his team would like to see TWIPS used in harbor protection as well as an aid in the identification of marine sediments and manufacturing. Further research could lead to TWIPR (twin inverted pulse radar), which could be used to [detect explosives](#) or covert circuitry.

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Why not just learn from nature?
By **littleprince** on 11/18/2010 11:55:48 AM , **Rating: 5**

Erg... Kinda a weird relation to dolphins.

Why didn't he just sit down and figure out how dolphins do it. Maybe it's even better than his method? Nature tends to have a good way of figuring things out

quote:

... instead of producing a bio-inspired sonar by copying dolphin signals, I sat down and worked out what pulse I would use if I were a dolphin.

RE: Why not just learn from nature?
By **MrBlastman** on 11/18/2010 12:43:31 PM , **Rating: 2**

Because our finned friends would have had to kill him if he found out. They keep plenty of secrets from us, quietly waiting for their day...

[Parent](#)

RE: Why not just learn from nature?
By **bitterman0** on 11/18/2010 1:06:55 PM , **Rating: 5**

"So long and thanks for all the fish," eh?

[Parent](#)

RE: Why not just learn from nature?
By **Anoxanmore** on 11/18/2010 1:27:08 PM , **Rating: 2**

Give it 100K more years (assuming earth doesn't suffer some huge natural disaster) and Dolphins are going to be the next Homosapiens.

I can't wait to talk to them! Even though I'll be dead. :` (

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[-] **RE: Why not just learn from nature?**

By **TeXWiller** on 11/19/2010 11:29:00 AM , **Rating: 2**

I, for one, welcome our bubbly Dolphin overlords of the future!

[Parent](#)

[-] **RE: Why not just learn from nature?**

By **VahnTitrio** on 11/18/2010 2:12:21 PM , **Rating: 2**

I think the main reason is bubbles really aren't all that much of an obstacle for most applications. The main reason for it is to know depth, and the second most useful application is a fishfinder. In those applications, you will certainly see the cloud of bubbles, but you will also still get a pretty good picture beyond those bubbles (as objects like the sea/lake floor are a lot harder and return a much stronger signal).

I wish I had an example stored on my fishfinder but I can show you what a boat passing you looks like on side imaging. Yes, there is a clouded trail off to one side, but it's not a particularly strong return, and pretty much had no "shadow" effect on objects beyond the bubbles. For comparison, I took this SS shortly after receiving my new toy (note this is a consumer grade product). Now my setting sucked so my image sucked, but even this traditional sonar was able to get a little bit of a return through solid concrete (those are bridge pilings).

<http://img.photobucket.com/albums/v354/vahntitrio/...>

[Parent](#)

[-] **RE: Why not just learn from nature?**

By **Solandri** on 11/18/2010 5:19:12 PM , **Rating: 5**

Bubbles in themselves are pretty impenetrable by sonar. How much of the sound wave is absorbed or reflected by a medium change depends on the ratio of the density of the two media. Going from low density to high density results in fairly good transmission (if you dive into a swimming pool, you can still hear people above). But going from water to air has such a huge ratio of high to low density that it results in almost perfect reflection. (If you're standing above the pool, you can't hear what's going on in the water.)*

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The image you're seeing through bubbles is because they're an imperfect screen - they have lots of gaps between individual bubbles. If it had been a solid sheet of air, you'd be getting no return beyond the bubbles. Concrete, metal, and stone are actually pretty easy to see through. Since their density is not *that* far off from water (typically 2:1 to 5:1 for stone to 10:1 for metal), they transmit a fairly good percentage of the sound wave when underwater.

I suspect by using twin inverted pulses, they're able to distinguish between the returns which come from the bubbles, and returns which come from something solid beyond. Then they can just subtract the bubble returns to get a clear(er) picture of what's beyond them.

*This is also the reason fish without swim bladders like tuna are harder to spot with fishfinders. Most of the signal return from a fish is when the sound wave hits the low-density swim bladder and has a perfect reflection. Fish without swim bladders are effectively stealth, and you need a more powerful transducer to get a readable signal off of smaller density changes like bone. (Muscle has almost the same density as water so generates very little return.)

[Parent](#)

RE: Why not just learn from nature?

By **Solandri** on 11/18/2010 5:20:22 PM , **Rating: 2**

I should add, for comparison, the density change from water to air is about 800:1.

[Parent](#)

RE: Why not just learn from nature?

By **Reclaimer77** on 11/18/2010 4:54:21 PM , **Rating: 1**

Because this isn't Babylon 5 and we can't build devices that are mechanical and yet are also biological?

[Parent](#)

RE: Why not just learn from nature?

By **Qapa** on 11/19/2010 4:13:04 AM , **Rating: 2**

I fully agree. I can only think this guy has a gigantic ego and didn't want to learn from

THROUGH:

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dolphins.

Or, maybe he was afraid dolphins had their sonar copyrighted :P

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[-] **if I were a dolphin** [↑]

By **Moishe** on 11/18/2010 4:51:05 PM , **Rating: 2**

Sounds like a new reality TV show.

How does he know what he would do if he were a dolphin? He doesn't know how a dolphin thinks.

What he did was sit down and apply his brain and skill to the problem. Dolphins have nothing to do with it, other than being the inspiration.

[-] **RE: if I were a dolphin**

By **JKflipflop98** on 11/19/2010 9:35:07 AM , **Rating: 2**

We don't really know that, unless of course you have some data showing that dolphins *don't* use this system while bubble net hunting?

[Parent](#)

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