seeking order in cluttered spaces

trex13: the target and reverberation experiment 2013

Narrator: The challenge is complex: find a way to help Navy sonars detect, identify, and classify potential underwater hazards – from inert rocks to deadly mines. And determine how to keep sonar signals from being overwhelmed by reverberations from the seafloor or non-hazardous objects.

Kevin Williams: If you go to a canyon and you shout into it, you'll hear an echo coming back. Well, you do the same thing in the ocean and you'll hear an echo coming back and that's the reverberation part of it.

So now think of that same canyon and you shout into it and at the same time there's an echo coming back; there's somebody shouting back at you who wants to give you a message — wants to tell you who he is. Well that's the target part. The target part is embedded in this big echo that's coming back at you. So in the ocean, it's the same problem.

Narrator: In the Target and Reverberation Experiment — TREX — APL-UW researchers measured mid-frequency reverberation. Searching for ways to detect hazards while screening out environmental reverberations caused by the bottom, by water temperature, by waves on the surface, and schools of fish.

Aubrey España: This is 15-m range, 20, 25, 30, 35 and 40. There are three targets out here. This one right here is actually a rock. So it was kind of one of these clutter objects that we were looking at. We're trying to provide the database of various types of targets you could be potentially looking for out there in the ocean.

Narrator: The dive teams assembled a 50-yard-long underwater target field, then used sonar to interrogate targets from various angles and ranges. Some targets were buried or partially buried in sediment.

Williams: And then we try to understand what is special about that target that allows you to know that it's that thing versus something that is different — that is, a barrel or an underwater refrigerator or whatever it might be that somebody threw out. So that's kind of the detection problem.

Narrator: The nearshore underwater environment proved to be complex. Reverberations came from mud, sand, shells, and the ever-present, always curious fish.

España: There are two things that happen — either they completely block the signal and you just get nothing back, or they basically scatter the sound a lot. But the good side of that is that it does give us a good set of realistic data because you're going to have the fish in the ocean when you go out to look for these things.

Narrator: The dive teams found targets to be characterized by certain acoustic features. Sonar pings not only bounce off targets, they cause targets to ring and resonate in unique and identifiable ways.

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Narrator: TREX13 moved previous findings from a controlled pond to the uncontrollable environment of the sea.

The goal is to model target acoustic responses in real-life scenarios and, in turn, improve Navy sonar's ability to detect and classify underwater hazards.

Williams: Our job is to use what we think are the sensor capabilities that they've developed and then back up and say two things: what's the physics of the target? How is that seen in the acoustics? How does that play out in the acoustics?

And then, in a certain sense, the Navy, even more so today than I think ever before, understands that they are going to be building a system — a sensor that is going to be part of a package. And they know that over the course of 30 years, the one thing they can do is upgrade their modeling capability or their signal processing capabilty for the system.

this is apl — the applied physics laboratory at the university of washington in seattle