Australia's National
Science Agency

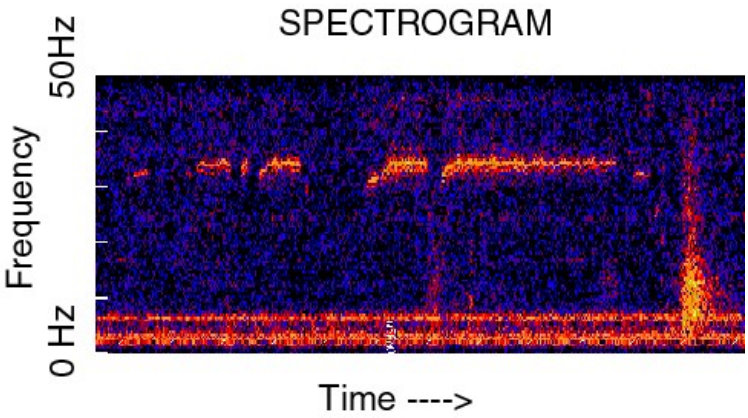
Covert Hydrophones

Monitoring illicit activities at sea with subsurface hydrophones

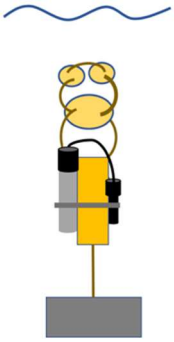
Subsurface hydrophones

Sound has long been used to monitor marine activities. Existing technologies can log vessel sounds, allowing detection and warning of activities in important areas. However, challenges occur when the surveillance technology must be hidden, or provide real-time data in remote locations. We are using CSIRO's expertise in marine engineering and mooring design to expand existing hydrophone equipment to covert applications.

The units function like other subsurface acoustic telemetry stations. The recording unit is attached to a weight for deployment, and retrieved using a remote to trigger the acoustic release.



Example output of data from a covert hydrophone



Acoustic release with SoundTrap hydrophone and external battery; Remote control deck unit; Schematic of deployed unit

Range and applications

Subsurface hydrophones are designed specifically to detect dynamite fishing and different types of vessel activity to inform patrols. They can detect loud noises (e.g. dynamite) within a 15km radius, and accurately identify vessel activities within a 2-5km radius. Analysis of acoustic data shows the location of the vessel or activity and additional information that can be useful to improve surveillance efficiency, such as the type of vessel (e.g. inboard versus outboard engines) and movement (e.g. transit, loitering, stopping and starting behaviours indicative of certain types of fishing). Over time, the hydrophone data can provide managers with detailed information on the locations, times, and types of vessel activities in their area.

Analysis

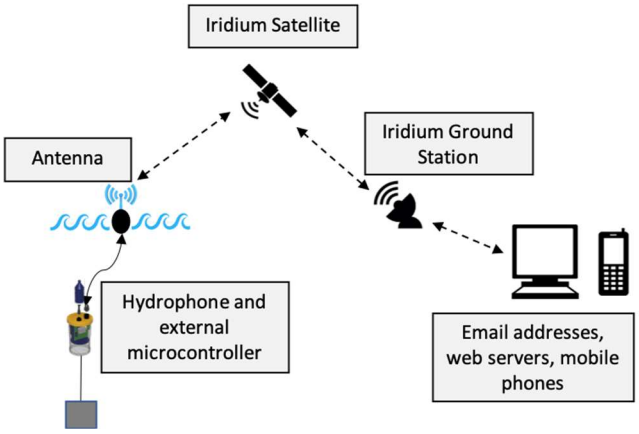
The acoustic files are large, so data is either moved via a hard drive, or we provide users with the analysis software we have developed. We can then run analysis remotely and provide outputs. Additionally, we have tools for users to do a preliminary visual exploration of the sound data themselves. Many sounds are easily identifiable (e.g. dynamite or large vessels).

Hydrophones are typically deployed for three months to avoid fouling, although the battery may last longer. The acoustic release is rated to 400m depth. The units have been successful even in strong currents and can be deployed and retrieved without a winch. Each unit is less than 20kg shipping weight, and includes all necessary materials apart from the mooring weight.

Project updates

Real-time covert hydrophones

We are developing low-cost, simple units tailored to specific surveillance needs. Our new hydrophone prototype can send alerts in near real-time to help patrols and enforcement of illicit activities. Certain types of noise (e.g. a vessel or a detonation) recorded on the hydrophone will trigger a message to an external microcontroller. A buoyancy-controlled antenna moves to the surface and transmits the information via an Iridium satellite. The messages can then be sent to phones, web servers, or emails.

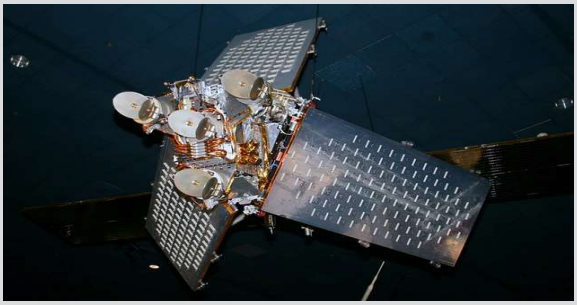


Schematic of the real-time covert hydrophone system

The microcontroller unit communicates between the hydrophone and the satellite. It processes messages from the hydrophone whilst supplying power to prolong deployment time. For users wanting to immediately respond to detected events, this is an improvement from the archival units where the hydrophone must be retrieved to manually download and process the data. Here, the detection and analysis of target frequencies takes place *in situ* and this information is translated into a message for the user (e.g. type of noise, power and distance, and confidence intervals).

Antenna float (left) and housing for microcontroller unit and electrical components (right)

Currently, the real-time prototype is limited to shallow depths (<20m) due to the mechanics of the tethered antenna buoy moving between the hydrophone and the water surface. We are working to expand the system's depth rating and make the antenna as covert as possible from the surface.



The Iridium satellites are an independent system built by Iridium and partners

Hydrophone lending library

We currently have a number of hydrophone units available for loan for up to a year, with shipping being the only cost to the users. We hope to be able to provide longer-term or permanent units in the future.

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