Underwater acoustic localization of marine mammals and vehicles

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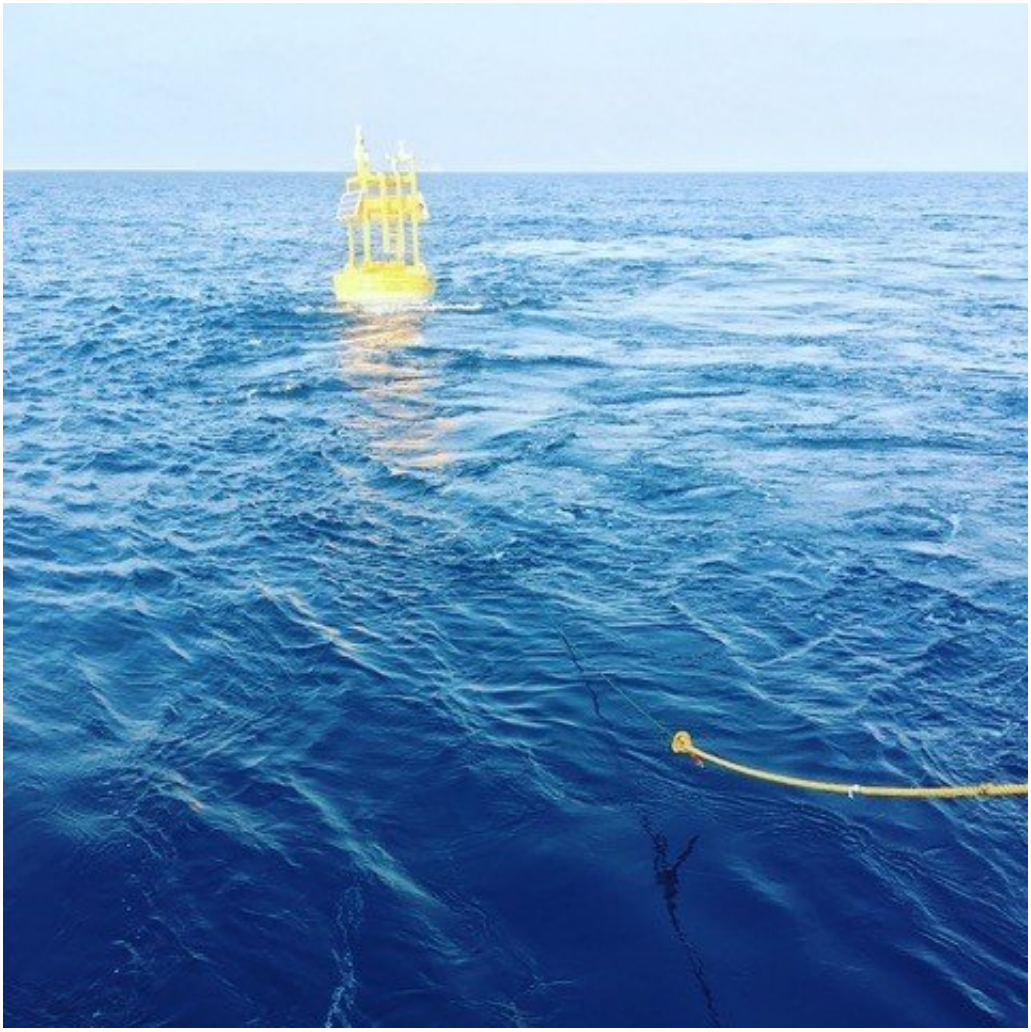
Elizaveta Dubrovinskaya during the experiment on a boat off the coast of Northern Israel. She was acquiring data from an underwater acoustic communication system using a “rugged” computer, specifically designed to operate reliably in harsh usage environments and conditions. Credit: IMDEA Networks Institute

Researchers at IMDEA Networks (Spain) in collaboration with University of Haifa (Israel) have developed an underwater acoustic system for the localization of marine mammals, underwater vehicles and other sound sources in the ocean, using no more than a single hydrophone (basically an underwater microphone) as a receiver.

Understanding the oceans, which cover two thirds of the Earth's surface and contain information about climate, the history of our planet and yet-to-be-explored energy resources and forms of life, is essential to the future of our planet. Acoustic wireless information transmission through the oceans is one of the technologies enabling the development of future ocean-observation systems, a stepping stone towards gaining a better perception of so many pivotal issues the oceans seem to hold the key to.

This new collaborative research effort has focused on one aspect of information transmission underwater: a simpler, more efficient and less costly system for the localization of sound sources found in the oceans. Nowadays the cost of covering a broad area of the ocean with multiple receivers to locate marine mammals or underwater vehicles based on the acoustic signals they produce is excessively high. Thus, this international team of researchers has set itself the objective of resolving the problem of how to estimate the trajectory of a submerged source that emits acoustic signals without using any anchor nodes or a receiving array.



Acquiring experimental data from an underwater acoustic communication system on a boat off the coast of Northern Israel. The depicted buoy belongs to the project THEMO. Credit: IMDEA Networks Institute

As conventional localization algorithms such as those used in GPS-like systems cannot be directly ported to an underwater scenario, in this innovative system the localization is performed thanks to the incorporation of additional information about the environment surrounding the receiving hydrophone.

In particular, the system relies on information about the variation of

submarine topography, of the depths and shapes of underwater terrain, known in technical terms as "bathymetry". These variations that are registered along different directions from the receiver induce changes in signal propagation, and these changes are then modeled and used to discriminate the location of the source of the signal. The result, after the calculations have been cleared of residual "noise", offers a close estimate of the trajectory of the source of sound under examination.

The scientists responsible for this work consider that the location estimations obtained with this system will contain minimum errors provided that the receiver has sufficiently accurate and up-to-date environmental information. The simplicity of implementation and deployment of the innovative underwater localization system designed makes it even possible for applications that have strict size, power and deployment cost limits to achieve localization.

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More information: Anchorless Underwater Acoustic Localization. In: IEEE 14th Workshop on Positioning, Navigation and Communications (WPNC 2017), 25-26 October 2017, Bremen, Germany. eprints.networks.imdea.org/167 … erwater-acoustic.pdf

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