Image Credit: NOAA

National Aeronautics and Space Administration

NASA

TECHNOLOGY SOLUTION

Sensors

Extreme Low Frequency Hydrophone

Senses and isolates infrasound down to .0001 Hz while submerged

The Extreme low frequency infrasonic hydrophone, with the associated software, is capable of sensing down to .0001 Hz, a 4.999 Hz improvement from current similar systems. This ultra-low power consuming hydrophone also isolates and removes significant amounts of background noise, inherent to the electret type microphone not previously introduced into hydrophone applications.

The uniquely robust unit design also permits for sub-freezing operations deep below the surface.

The results promise to drastically alter lives and multiple industries, enabling totally new data for weather monitoring and earthquake/tsunami prediction among numerous other academic applications. It could also improve current hydrophone accuracy or reliability in finding oil resources, and will enable monitoring human generated infrasound in water.

BENEFITS

- Frequency range from .0001 Hz up to 100 Hz detection range
- Electret based design eliminates more background noise than other hydrophones
- Can be used in high pressure marine environments
- Can be used to detect infrasound below freezing temperatures
- Low power consumption

THE TECHNOLOGY

The extreme low frequency hydrophone boasts unprecedented capability for precise detection as proven in testing, where it sensed wave range between surface waves and tidal surges with periods between .3 and 30 seconds, or 3 to .033 Hz.

The technology uses a back-electret microphone, inherently reducing noise, in a stainless steel body. The stainless steel diaphragm conducts infrasound well and the material's robust nature and internal configuration facilitates sub-freezing and deeply submerged sensing of sound down to .0001 Hz.

With an appropriately spaced array of three hydrophones it is possible to determine the direction of origin of a submerged infrasonic source, the addition of one more in another location will also enable determination of the precise location of origin.

The oil industry uses existing infrasound systems to locate undersea oil deposits and this technology could potentially improve the accuracy or reliability of current practices. It could also be used to give tsunami and earthquake warnings, monitor ships, and to generate electrical energy from infrasound. This technology has potential to unlock new industry uses not currently understood due to the unprecedented nature of its capabilities.

Image of prototype hydrophone. Image Credit: NASA

APPLICATIONS

The technology has several potential applications:

- Offshore oil industry
- Weather monitoring (earthquake, tsunami and tidal)
- Monitoring wind-generated gravity waves on the free surface of the bodies of water
- Monitoring of man-made infrasonic sources such as boats
- Piezoelectric design allows for energy harvesting from full detection range

PUBLICATIONS

Patent No: 11,399,231; 10,802,107

technology.nasa.gov

NASA's Technology Transfer Program pursues the widest possible applications of agency technology to benefit US citizens. Through partnerships and licensing agreements with industry, the program ensures that NASA's investments in pioneering research find secondary uses that benefit the economy, create jobs, and improve quality of life.

LAR-19681-1, LAR-19059-1, LAR-TOPS-321

More Information

National Aeronautics and Space Administration

Agency Licensing Concierge

Langley Research Center

Mail Stop 020
Hampton, VA 23681
202-358-7432
Agency-Patent-Licensing@mail.nasa.gov

www.nasa.gov

NP-2019-04-2695-HQ