

► Wilcoxon Research, Inc.

Advances in Minature Underwater Vector Sensor Technology

About the technology

Directional underwater sensors have two appealing capabilities; the ability to selectively reject noise emitted from discrete interfering noise sources and the ability to localize, track, and range targets using acoustic intensity-based algorithms. Specifically, acoustic “vector” sensors are directional underwater sensors that measure acoustic pressure and each orthogonal component of a particle’s acoustic acceleration in a single housing

with a common center of detection.

Until recently, vector sensor technology for towed array applications had not met the Navy’s requirements due to limitations in the sensor’s signal-to-noise ratio, issues of neutral buoyancy, and the robustness of the design. Wilcoxon Research,

Inc. met and exceeded the Navy’s requirements through the use of a new piezoelectric material (PMN-PT crystals), a patented electromechanical sensing mechanism, and specialized low-noise signal amplification. The exploitation of the highly sensitive PMN-PT crystal allows the size of previous vector sensors to be reduced in volume by almost a factor of ten. This sensor is neutrally bouyant in water and weighs less than 60 grams. To further enhance the sensors performance, a novel method to mechanically amplify the strain¹ induced into the crystal was utilized. Finally, an extremely low noise amplifier was designed to interface specifically to the new piezoelectric material to allow the sensor to meet the Navy’s ultra-low noise requirements.

These sensors enable efficient generation of narrowly formed beams which can be adaptively modified to place desired nulls in the beam pattern for any direction. They can also estimate the direction of arrival (DOA) from an acoustic source by means of the time average of the acoustic intensity vector. Two or more vector sensors used in conjunction can estimate the range to that acoustic source.

Military and commercial significance

The Navy’s detection systems are continuously looking for more accurate and efficient methods to detect acoustic targets. A vector sensor allows the location of a target to be determined in a more accurate and efficient manner when compared to a traditional Omni-directional hydrophone. A vector sensor could be used to replace hydrophones in existing and future line and towed arrays. They could also be used in Homeland Security applications where advanced notice and location of unwanted sea-going vessels could be crucial to the security of a harbor or port.

Applications

- Line Arrays
- Towed Arrays
- Directional Hydrophones
- Advanced Sonar
- Port Perimeter Security
- Oil Exploration
- Geophysical Research



About the company

For more than 40 years, Wilcoxon Research, Inc. has been manufacturing a wide range of vibration sensors that are used worldwide in a variety of industrial, process control, military, and test & measurement applications. Wilcoxon Research, Inc. also provides the latest in Bluetooth Wireless systems for the process control market. In addition to providing a core product line, Wilcoxon Research, Inc. has a Wilcoxon Research Labs group that focuses on state of the art basic and applied research topics for a variety of Military and Government agencies.

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- Wilcoxon Miniaturized Vector Sensor compared to previous Vector Sensor

***fyi** Wilcoxon was awarded a Phase III contract to produce the miniature vector.*

- **SBIR Investment: \$350K**
- **Project Revenue: \$500K**