Department of the Navy SBIR/STTR Transition Program

DISTRIBUTION STATEMENT A. Approved for public release. Distribution is unlimited.
NAVSEA #2023-0420

Topic # N192-120
Small-Scale Velocity Turbulence Sensors for Undersea Platforms
NanoSonic, Inc.

WHO

SYSCOM: NAVSEA

Sponsoring Program: SEA073, Advanced Submarine Systems Development

Transition Target: Navy submarines and Unmanned Undersea Vehicles (UUV) are the primary target platforms for this type of sensor

TPOC: (401) 832-7096

Other Transition Opportunities: The sensors can be applied to new or existing undersea platforms for real-time velocity analysis.

Image Courtesy of NanoSonic

Notes: NanoSonic is developing high speed, miniaturized nanomembrane based travel-time sensors (inset) for small-scale velocity turbulence measurements. Such sensors are implemented using a pair of serial-mounted high frequency pressure wave sensing elements and supporting data acquisition and signal processing electronics in conformal skins. The developed sensor skins are thin, flexible, mechanically and chemically robust thus can be patterned in two dimensions to create multi-sensor element arrays that can be embedded into undersea system structures.

WHAT

Operational Need and Improvement: The Navy currently is looking for a permanent way of measuring small-scale ocean turbulence from submerged platforms for extended periods. Traditional techniques for the undersea turbulence detection are fragile, noise-susceptible, scale-limited and are not suitable for high-speed applications.

Specifications Required:
o Improved turbulence sensing response
o Conformal sensor installation
o Small size and weight
o Low cost
o Robust operation

Technology Developed: High speed, miniaturized nanomembrane based travel-time sensors for small-scale velocity turbulence measurements. Such travel-time-based velocity sensors will be implemented using multiple high frequency pressure wave sensing elements and supporting data acquisition and signal processing electronics. Such sensors exhibit frequency response significantly higher than state-of-art products and that improved frequency response is the basis of our turbulence sensor approach and can be applied to new or existing undersea platforms for real-time velocity analysis. The performance in terms of small-scale turbulence detection of the sensors has been experimentally demonstrated through multiple laboratory-based tests.

Warfighter Value: Accurate measurement of undersea small-scale velocity turbulence will provide the user with additional situational awareness capabilities.

WHEN

Contract Number: N68335-21-C-0262 **Ending on:** Sep 26, 2022

Milestone	Risk Level	Measure of Success	Ending TRL	Date
Build breadboard-level miniaturized sensors for undersea velocity measurements	N/A	Completion of in-house validation	3	2nd QTR FY20
Characterize the breadboard-level sensors using equipment available at Virginia Tech	N/A	Completion of initial water tunnel testing at Virginia Tech	4	3rd QTR FY20
Standardize the sensor design and fabrication process	Low	Completion of water tunnel testing at Virginia Tech	5	4th QTR FY22
Develop and optimize a data acquisition interface to allow interconnection to data recording systems	Low	Completion of tunnel testing at Navy	5	4th QTR FY23
Use developed sensors in cooperation with the Navy program through in-water bay testing	Medium	Completion of bay testing at Navy	6	4th QTR FY24
Develop product transition plan	Medium	Completion of demonstration of sensor elements in multiple research testbeds	6	4th QTR FY24

HOW

Projected Business Model: NanoSonic specializes in the design and manufacture of innovative materials, especially new materials that are currently unavailable in the commercial market. We design and manufacture materials with novel engineering behaviors with the overall goal to develop environmentally benign processes and techniques for these new materials. The sensor products developed through this Navy SBIR program build on our established capabilities in both the nanomaterials and sensors and systems areas, where we already have commercialized products, have licensed multiple technologies, and hold multiple issued U.S. patents.

Company Objectives: NanoSonic envisions use of developed technology first by the Navy programs, and then by the broader research community, as well as the developers and users of aerospace, hydrospace, land vehicle, civil structure, and biomedical flow systems. There is a very wide spectrum of applications of this technology. Any application requiring a turbulent velocity measurement (air or sea) or long term deployment can benefit. The oceanographic community (universities and research institutes) are good examples of organizations that would benefit from the technology. We seek discussions with interested parties.

Potential Commercial Applications: To maximize use of the velocity sensor technology, this sensor technology could be commercialized for use by the oceanographic community at large for scientific and research uses. Organizations interested in oceanographic research and data collection such as universities will find high value in these sensors.

The commercialization potential of the velocity sensor technology lies in three areas - 1) sensors for the measurement of high frequency pressure profiles, 2) travel-time sensors for the measurement of high frequency velocity profiles, and 3) data processing modules.

Contact: Hang Ruan, Director of Engineering, Vice President of Sensors and Systems
hruan@nanosonic.com (540) 626-6266