

Topic: N18A-T017

Makai Ocean Engineering, Inc.

Temperature Sensing Submarine ISR Buoy / Surface Ship Sensor Tow Cable

The Distributed Temperature Sensing (DTS) Tow Cable uses fiber optics embedded within a surface or subsurface vessel's tow cable in order to accurately measure water temperature in the highly variable upper mixed layer of the ocean. The DTS is integrated into the vessels' existing towed cable systems instead of relying on unreliable predictive modeling and expendable bathythermographs. Makai Ocean Engineering (Makai) is well known for our work with subsea cabled systems including innovative software and hardware systems. The DTS unit itself is low risk and has been used for other applications. Makai has developed the fiber optic embedment technique, and is currently testing a prototype tow cable for performance and durability. We are looking for assistance in transitioning and integrating this technology throughout the fleet.

### Technology Category Alignment:

Sensors

Advanced Electronics

Ground and Sea Platforms

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**SYSCOM:** ONR

**Contract:** N68335-19-C-0522

 Corporate Brochure: [https://navystp.com/vtm/open\\_file?type=brochure&id=N68335-19-C-0522](https://navystp.com/vtm/open_file?type=brochure&id=N68335-19-C-0522)

Department of the Navy SBIR/STTR Transition Program

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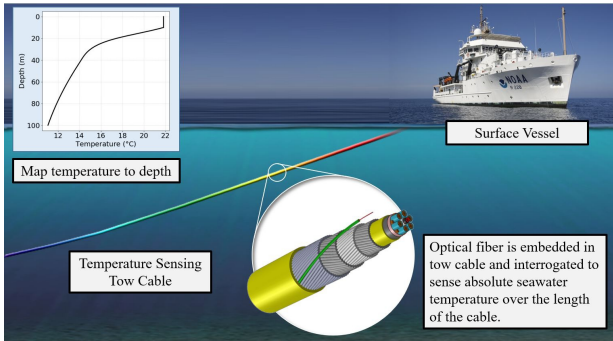
WHO

**SYSCOM:** ONR  
**Sponsoring Program:** NAVSEA 073, Advanced Undersea Technology, submarine ISR buoy development project, PMS435

**Transition Target:**

**TPOC:**  
Dr. Charles Traweek  
[mike.traweek@navy.mil](mailto:mike.traweek@navy.mil)

**Other transition opportunities:** Other transaction opportunities within the Navy include the Navy's surface fleets, and other oceanographic applications. Makai will work with NAVOCEANO to identify additional oceanographic applications for the temperature sensing tow cable that will benefit the Navy. These may include tow cables for oceanographic vessels, and buoys with distributed temperature sensing mooring cables among others. Other non-Navy transition opportunities include similar oceanographic applications for National Oceanic and Atmospheric Administration (NOAA), research institutions, and other commercial applications.



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WHAT

**Operational Need and Improvement:** In order to determine the seawater temperature in the water column, ships use predictive models in combination with continuous monitoring of seawater injection temperature at a single depth and intermittent bathythermograph measurements. The accuracy of this method is limited due to uncertain effects of currents spanning the water column. The Navy needs the ability to accurately measure the temperature throughout the water column using the tow cables already on-board the vessels.

**Specifications Required:** Use fiber optic temperature measurement technology to measure the water temperature and be both compatible with legacy surface ship sensor and communications systems employing a tow cable. Measurements shall be taken every second and accurate within <0.5° Celsius error along any 0.5-meter segment of the tow cable.

**Technology Developed:** Makai has developed a tow cable system that can accurately measure in the real-time the distributed seawater temperature along the length of the cable when towed from a surface ship. Makai's team has develop a method of embedding fiber optic cable into tow cables and interrogating the fiber to measure seawater temperature from the tow platform using Distributed Temperature Sensing technology.

**Warfighter Value:** The technology Makai has developed for this project provides critical information to topside vessels that will improve accuracy of seawater temperature measurements throughout the upper portion of the water column. Makai's system provides a seawater temperature accuracy of less than 0.5° C. This accurate, real-time, truth data will assist with on-board operations. Makai's system also leverages existing tow cable deployment hardware and removes the need for expendable bathythermographs.

WHEN

Contract Number: N68335-19-C-0522    Ending on: August 31, 2023

Milestone	Risk Level	Measure of Success	Ending TRL	Date
Test prototype cable and COTS DTS system in lab setting	Med	Prototype cable meets the Navy's temperature sensing accuracy and collection rate requirements in a lab setting	4	1st QTR FY20
Pier-side and lab testing of tow cable and miniaturized DTS unit	Low	Full system prototype meets the Navy's temperature sensing accuracy and collection rate requirements in a lab setting	5	1st QTR FY21
Full Distributed Temperature Sensing Tow Cable prototype tested on vessel of opportunity in a relevant environment	Med	System meets all Navy temperature sensing accuracy and collection rate requirements in a relevant environment	6	4th QTR FY23

HOW

**Projected Business Model:** Our team will engage with ONR and key stakeholders at the surface fleets to socialize the capability and its benefits, gain stakeholder buy-in, and establish timelines for prototype testing and ultimately the transition to operational systems. Makai will sell these systems directly to the Navy. Makai will use the trusted supply chain developed during PhII efforts to competitively source parts, assemble and calibrate equipment in-house, and deliver to the customer.

A final temperature sensing solution incorporated into an operational system for at-sea testing and evaluation would be part of a Phase III project. Makai estimates that 12-18 months after the completion of the Phase II project, we could have fully functional systems built and demonstrated at-sea on an operational gray hull platform to a TRL 7.

**Company Objectives:** While Makai is already known worldwide for our subsea cable and array modeling software, this and other technologies currently being developed are allowing Makai to expand into cable related hardware systems. This program will allow Makai to expand into other cable hardware markets.

**Potential Commercial Applications:** There is market potential for similar distributed temperature sensing tow cables within the oceanographic community, including research vessels. Other, derivative commercial applications include systems such as buoy moorings. This project ties together well with Makai's work on another SBIR program where we are developing a fiber optic mooring system for small communications buoys. This distributed temperature technology tied with the ability to moor a buoy using a fiber optic cable provides an attractive, low cost solution to NAVO, NOAA, and other oceanographers for enhanced ocean data. The buoy would collect temperature data for the entire water column using the mooring line.

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