DEPARTMENT OF THE NAVY
SBIR/STTR TRANSITION PROGRAM

SUCCESS STORY

TOPIC NUMBER: N11A-T017

SBIR INVESTMENT: $1,803,252

PHASE III FUNDING: $4,000,085.50

UNDERWATER SENSOR SYSTEM AUTONOMOUS BURIAL AND OPERATION

Makai Ocean Engineering, Inc. pioneered a bottom-skimming autonomous underwater vehicle (B-SAUV) to deploy cables and sensing equipment on the seafloor, saving time and cost.

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THE CHALLENGE

The current method of installing sensor systems on the sea floor involved a mothership towing a sled-type vehicle from which the sensor system deployed. This method of deployment was time consuming and costly, as the mother ship used fuel to tow the vehicles. The Navy sought innovative approaches to install, bury, power, and communicate from a bottom mounted underwater sensor system, specifically, an autonomous underwater vehicle (AUV). Most AUVs are designed for general purpose missions or special tasks, such as hull inspection, but none were designed for the specific task of sensor burial.

THE TECHNOLOGY

Makai Ocean Engineering and the University of Hawaii worked together to develop an AUV that is used to lay cables on the seafloor without a tether and without assisted navigation. Known as the bottom-skimming AUV or B-SAUV, it deploys seafloor sensing equipment by combining the features of a free-swimming AUV and those of a bottom-crawling vehicle. Propelled by thrusters, the B-SAUV can touch, glide along and interact with the seafloor by controlling its wet weight and buoyancy. In low buoyancy, the B-SAUV presses on the seafloor with its full wet weight. During medium buoyancy, the B-SAUV glides along the bottom at a desired wet weight to adjust for existing bottom conditions. At high buoyancy, the B-SAUV floats temporarily above the bottom in the water column in order to overcome obstacles. The B-SAUV's buoyancy is controlled by a computer hardware and software system. This computer system also enables the B-SAUV to autonomously navigate to a predefined location, install, and log data from oceanographic sensors in the seafloor. B-SAUV carries the sensors, which can be used for environmental monitoring or remote sensing, as payload within its body.

THE TRANSITION

Coordinating with the Naval Information Warfare Systems (NAVWAR) Center, San Diego, Makai developed analysis and simulation software tools to model the behavior of undersea cables and towed arrays. Based on this work, Makai partnered with the University of Hawaii under an STTR Phase II award to develop an AUV which reliably and autonomously interconnected power and burial to undersea nodes after they had been deployed. An SBIR Phase II was awarded Makai to enhance aspects of the previous STTR Phase II technology of the installation support system (ISS) development and to facilitate an accelerated transition to a fully realized Fleet capability. An SBIR Phase III contract was awarded to Makai by NAVWAR; Naval Sea Systems Command (NAVSEA) has been purchasing the technology as well.

THE NAVAL BENEFIT

Makai's B-SAUV enables the installation and connection of a network of power, data and sensor elements on the sea floor without the use of a surface ship or remotely operated vehicle. Because the B-SAUV carries the sensors as payload, the need for a surface ship to tow a sled-type deployment vehicle is eliminated, thereby reducing fuel costs. B-SAUV's light weight and compact build minimize propulsion requirements, which decreases component sizes and overall costs. In addition, B-SAUV's autonomous nature allows it to navigate and bury the sensor system quickly and reliably.

THE FUTURE

Makai is collaborating with the Navy on other projects. Under another Navy SBIR topic, Makai has developed an instrumented tow cable (ITC), which can accurately measure in real-time the distributed seawater temperature along the length of a cable when towed from a surface ship. The Navy has used Makai's cable lay modeling for various installations. Additionally, the Navy has been the primary sponsor of Makai's ocean thermal energy conversion (OTEC) technology as a renewable power source.

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