

WHO

SYSCOM: NAVSEA

Sponsoring Program: IWS6

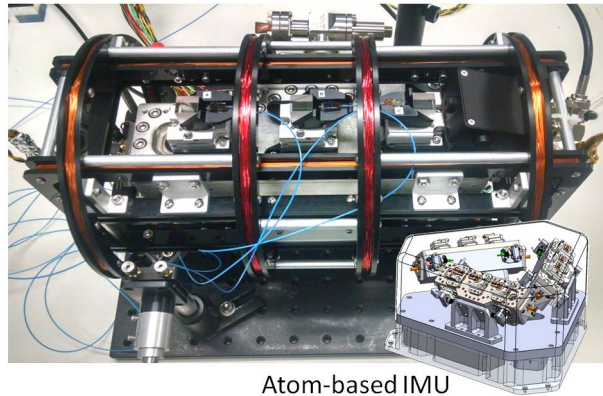
Transition Target: Navigation system for Navy surface ships and attack submarines (SSN)

TPOC:
(202) 781-5094

Other transition opportunities: Navigation in GPS-inaccessible or actively denied environments:

- Aircraft
- Guided munitions
- Satellites
- Autonomous vehicles

Single-axis gyroscope/accelerometer



Atom-based IMU

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WHAT

Operational Need and Improvement: Inertial navigation systems are a critical DOD asset when GPS is either unavailable or actively denied. Submarines, ballistic missiles, autonomous vehicles, and spacecraft all rely critically on inertial measurement units (IMU) to aid or provide positioning and orientation. Recent efforts to reduce military and civilian reliance on GPS have greatly increased demand for inertial sensors.

Specifications Required: Gyroscope performance is the critical limiter in navigation accuracy; better precision and bias stability will improve IMU performance. AOSense's atom-based gyroscope can provide improvement in precision and stability over current laser-based gyroscopes. SWAP, longevity, and environmental robustness are key factors for operational capability in navy surface ships and SSN's; performance and form factor can be traded to meet the needs other platforms.

Technology Developed: Atom-optical inertial sensors have demonstrated superior performance over conventional inertial devices owing to the intrinsic stability of the atom. By partially trading the exquisite performance of these lab-based sensors for size and simplicity, AOSense is developing a complete IMU with target performance surpassing the current navigator used by Navy surface ships and attack submarines.

Warfighter Value: AOSense is developing precise inertial measurement units (IMU) for navigating without reliance on GPS. Atom-based inertial sensors can provide more accurate positioning than current laser-based technologies, extending mission duration for Navy ships and improve targeting accuracy for guided munitions.

WHEN

Contract Number: N00024-14-C-4062 **Ending on:** February 1, 2016

Milestone	Risk Level	Measure of Success	Ending TRL	Date
Two-axis sensor demonstration	Med	Meet noise and stability specifications	3	February 2016
Dynamical operation of sensor	Med	Maintains specifications during dynamics and environmental changes.	4	August 2016
Full (three-axis) sensor	Med	Full Inertial measurement unit (three-axis sensor) meeting the above criteria	5	February 2017

HOW

Projected Business Model: AOSense will control all steps in the process of taking the atomic IMU from prototype to product. Systems will be manufactured in-house, providing control of subsystem integration. AOSense-validated companies will supply key OEM components, such as laser diodes, high-frequency RF components, and machined parts. AOSense has extensive experience working with machine shops, custom optics vendors, and electronics shops to procure custom components. Currently, AOSense is growing its assembly and engineering teams to meet steadily increasing customer demand.

Company Objectives: AOSense's is a leading developer of innovative atom-optic devices for precision position, navigation, and timekeeping in the absence of GPS. Our capabilities include gyroscopes, accelerometers, inertial measurement units (IMUs), and atomic clocks. Atom-optic devices use frequency-stable lasers to manipulate and track atoms freely falling in a vacuum cell, resulting in accuracy and stability that greatly surpasses the performance of conventional sensors. AOSense scientists have demonstrated lab-based atomic sensors that set the standard for precision measurements of time and inertial forces and they are now engineering fieldable atom-optical measurement tools.

Potential Commercial Applications: Inertial navigation is a critical resource for commercial aerospace. Resupply services such as Space X's Falcon 9 rely on inertial measurement units (IMUs) to provide heading and stabilization for their flight control systems. Other applications include: positioning and heading for autonomous vehicles; detecting density anomalies via measurements of local gravity for oil, gas, and mineral exploration; compact atomic clocks for CubeSat-based GPS.

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