

**WHO**

**SYSCOM:** NAVSEA

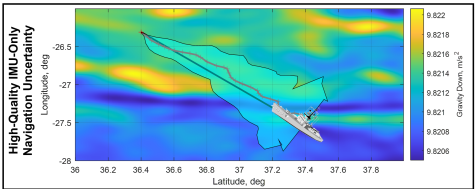
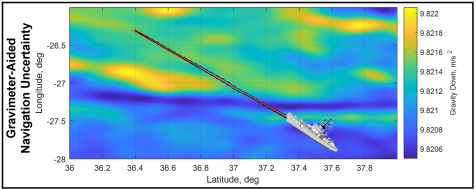
**Sponsoring Program:** Naval Surface Warfare Center Dahlgren Division

**Transition Target:** United States Navy (USN), Unmanned Surface Vehicles such as Optionally Unmanned Surface Vessel (OUSV), Medium Unmanned Surface Vehicle (MUSV), and Large Unmanned Surface Vehicle (LUSV)

**TPOC:** (540) 653-1296

**Other Transition Opportunities:** Commercial transport ships could use this technology as a resilient navigation system to maintain critical localization information. An example involves ships targeted by pirates; they could travel without detection and with robust navigation estimation.

**Notes:** Simulations involving realistic gravity-field errors have been completed. Many of the challenging theoretical aspects of the work have been addressed. Sea-trial experiments using a Lockheed Martin provided gravimeter are the next step.



Navigation Performance with and without Gravimeter

**WHAT**

**Operational Need and Improvement:** GPS signals are incredibly weak. They are prone to interference, and they are vulnerable to jamming as well spoofing, in which another signal by an attacker is passed off as the original. Alternative sensing capabilities that do not rely on external signals, such as the GPS, are needed to provide a resilient navigation solution.

**Specifications Required:** Hardware will be provided by Lockheed Martin. The gravimeter hardware from Lockheed Martin is a working unit and it has been used by the Navy. However, since OUSV is a new platform for this technology, OUSV navigation system requirements need to be reviewed and accommodated.

**Technology Developed:** The final navigation product is unmanned, passive, and free of the GPS or similar external reference aides. The baseline configuration is a hardware/software augmentation to an existing onboard inertial navigation system that fuses its dead-reckoned solution with data provided by a new strapdown vector gravimeter, a gravity database, water speed sensors, and depth measurement derived from a pressure sensor (possibly omitted for strictly surface vessels).

**Warfighter Value:** Stealth navigation of unmanned surface vehicles are ideal applications of the gravimeter-aided navigation filter. Additionally, underwater vehicles (manned or unmanned) would greatly benefit from the robust, silent nature of the gravimeter-aided navigation system.

**WHEN**

**Contract Number:** N68335-22-C-0137

**Ending on:** Nov 29, 2022

Milestone	Risk Level	Measure of Success	Ending TRL	Date
Algorithm Refinement and Simulation	Low	Algorithm works as planned	2	4th QTR FY23
Test Plan	Low	Gather information for sea trial test	2	1st QTR FY24
Execute Filter with Real Data	Medium	Performance accuracy of gravimeter-based solution	3	3rd QTR FY24
Python-Code Development	Low	Test accuracy compared to MATLAB with Navy Simulator code	4	4th QTR FY24
Mission Mode Development	Medium	Successful test on Navy vessel	5	3rd QTR FY25

**HOW**

**Projected Business Model:** Initial sales to Navy for use on vessels. The concept includes integrating a legacy INS (e.g., WSN-7 or WSN-12) with a gravity sensor and navigating using a map-matching approach. Expected USN surface ships benefitting from this capability include Aegis, DDG, LCS and CVN platforms. Collaboration with Lockheed Martin will be essential for platform transition.

**Company Objectives:** USN SSNs, SSBNs and UUVs all have the need for covert navigation for mission success. The USN is committed to providing Assured Position Navigation and Time to all naval platforms. The gravimeter-aided inertial navigation concept is a completely passive, non-jammable approach for navigation error control providing independence from GPS and other external sensors. Integrating this technology as part of the platform onboard equipment opens much larger markets.

**Potential Commercial Applications:** While the primary customer to be targeted for this technology is the military due to its operations in and around areas of GPS-denial, an additional audience that XAnalytix Systems will explore as potential customers is the commercial sector. Even today, GPS outages or unintentional jamming can cause serious issues with commercial vessels. This is underscored by an actual event where a tanker had to navigate Cyprus' shoreline in the dark because the GPS signal suddenly disappeared.