Navigation and Timekeeping

ONR Code 31

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At a Glance

What it is

- The Office of Naval Research (ONR) Navigation and Timekeeping program aims to provide naval forces with state-of-the-art position, navigation and time (PNT) capabilities for accurate, assured operational maneuver and optimum weapons employment.

How it works

- The program addresses various issues associated with PNT sciences and technologies, such as Global Positioning System (GPS) receiver vulnerability mitigation, precision time and time transfer, and non-GPS navigation systems, such as inertial navigation system and bathymetric navigation.

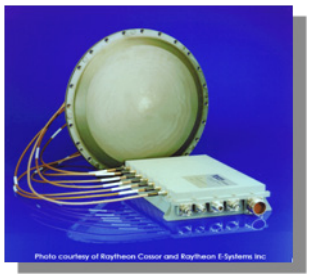
What it will achieve

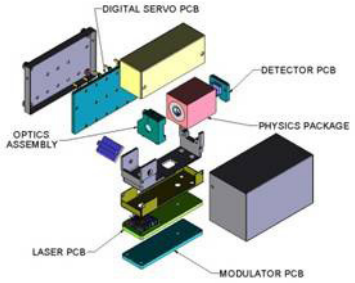
- The Navigation and Timekeeping program will enable a competitive advantage across the full spectrum of naval and joint warfare. It will equip the fleet and forces with an optimized mix of navigation sensors, allowing them to safely navigate and carry out assigned missions. The program will: accomplish GPS vulnerability mitigation via antenna nulling and signal processing during prolonged denial of a GPS signal; fully support alternative methods of navigation and positioning; and provide naval forces with an instantaneous time-tagged position with integrity.

Point of Contact

Stephen Pappert
stephen.pappert@navy.mil

U.S. military forces prefer GPS navigation because of its reliability and ease of use. However, GPS signals are vulnerable to enemy jammers. The Office of Naval Research is investigating these vulnerabilities and methods to systematically eliminate these weaknesses to provide the Department of Defense with a robust navigation capability.





- **GPS vulnerability mitigation:** Initial efforts focused on electronically steered GPS antenna systems, featuring antenna that preferentially select the intended satellite source and reject spatially inhomogeneous noise and jammer sources. Present interest involves developing controlled radiation pattern antennas for specific naval platforms, such as ships, airborne platforms, guided munitions, unmanned air vehicles and unmanned underwater vehicles. This thrust also addresses the coupling of GPS with inertial systems.
- **Precision time and time transfer:** Ongoing areas of interest in this technology arena are concerned with developing tactical-grade atomic clocks that possess unique long-term stability and precision. Additionally, this thrust explores the capability of: (1) transferring GPS-derived 1 pulse per second universal coordinated time via radio frequency links, such as the Joint Tactical Information Distribution System (Link-16); and (2) maintaining a common reference time by tying together existing time standards distributed in the various systems.
- **Non-GPS navigation:** This technology area focuses on: developing a correlation navigation technique using earth maps of high precision (including bathymetric, magnetic and gravitometric data); developing devices using wide-ranging physical principles and phenomena, such as gravity gradiometers and celestial navigation (CNS); developing gyroscopes that employ compact microelectronic mechanical system devices and fiber optics; and developing a CNS through the use of improved optical components, approaches and the incorporation of higher-resolution charge-coupled device focal planes.

Research Challenges and Opportunities:

- GPS anti-jam and anti-spoof technology development
- Development of tactical grade atomic clocks that are small (10 cc), low power (less than 1 watt), robust (military qualified) and low cost
- Development of an inertial navigation system with advanced optical fiber or MEMS