07 Optical Physics Company

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Phase III Success: Over $3 million through contracts with the Navy and private investments
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GLOBAL POSITIONING SYSTEM (GPS) is heavily relied upon by airborne Navy platforms in order to accurately gauge one's location on the Earth. This location knowledge usually includes heading, altitude, and the latitude and longitude of the Earth coordinates directly below the aircraft. GPS also impacts the success of many military missions, such as target tracking and missile and projectile guidance, making its presence a vital component of any military operation. But what happens when GPS becomes unavailable, whether from jamming, or entering a GPS-denied environment? The INS (Inertial Navigation System) component of GPS will accumulate errors, which degrade the accuracy of the system output. The longer the GPS signals are not available, the worse the error becomes.

Optical Physics Company (OPC), located in Calabasas, California, drew upon a centuries-old method to locate a solution and alternative for GPS navigation. Celestial Navigation is a process by which positions on the globe are measured using angles between celestial objects in the sky and the horizon. Whereas the archaic technique required a sextant, an almanac, and a clock, OPC developed a modern-day system using its patented interferometric star tracker. The resulting product is OPC's Optical Celestial Navigation System (OCNS), and it has been met with high demand across multiple industries. The OCNS operates independently of GPS, and cannot be jammed. The other major benefit to the fleet is its passiveness – OCNS does not give off any signals that could be detected by an enemy.

SWIR band interferometric star tracker for celestial navigation outfitted with IMU instruments

OPC's star tracker project got its start in 2006, when the team developed a star tracker design and demonstrated its high accuracy in the lab. A series of prototypes intended for spacecraft use followed. The military soon became very interested in finding alternatives to GPS due to jamming issues, and wanted a way to navigate using the stars. The method that OPC eventually proposed was selected by ONR, and the company began its Phase I SBIR work on a shortwave infrared (SWIR) band interferometric star tracker.

OPC continued working on its star tracker, and through a subsequent Phase II award, produced its prototype for use on airborne platforms. During the Phase II project, OPC participated in the Navy

Transition Assistance Program (Navy TAP), and presented a prototype design of the OCNS at the 2011 Navy *Opportunity Forum®*. However, it was the online presence within the Virtual Acquisition Showcase (VAS) leading up to the Forum that really catapulted the company into the limelight.

"While being at the Forum was great, being online as part of the Virtual Acquisition Showcase was even better," says Dr. Gail Erten, Marketing Director for Optical Physics. "A lot of interested customers are looking at that online showcase, doing the research ahead of time for keywords, or even looking at the whole list, and zooming in on specific booths. Those are the kind of customers we felt were real potentials for us."

Serendipitously, Northrop Grumman was browsing the VAS online, and called up Optical Physics directly. They noticed they were located only a short distance from their Los Angeles facilities, and proposed an in-person meeting, well before the actual Forum took place. The collaboration resulted in a Navy Rapid Innovation Fund (RIF) contract award and Phase III revenue for Optical Physics.

Under the Navy RIF, OPC's Optical Celestial Navigation System was outfitted with Northrop Grumman's inertial measurement unit (IMU) instruments resulting in a complete navigation system prototype, which will be field tested on stationary and moving ground base platforms followed by a flight test in mid 2014.

The major benefit of the star tracker system to customers is that it can be configured in a variety of ways depending on the platform. OPC has experimented with several alternative techniques to use the OCNS for navigation in GPS-denied environments, and is formulating different types of the system for those applications. They are also working with the Air Force for other applications of their star tracker for sensors serving space situational awareness missions.

Additionally, there exists vast potential for the interferometric star tracker's use on spacecraft. OPC is currently working on a miniature interferometric star tracker for cubesats (C-MiST) that will be delivered late this year.

Current projects on configuring the star tracker will result in a full product suite of OPC's interferometric star tracker that supports a variety of applications, ranging from spacecraft to ground based space situational awareness to celestial navigation, allowing both military operations and space exploration initiatives the certainty of unobstructed and precise geolocation capabilities.

Aircraft like this F/A-18 Hornet are target transition platforms for OPC's celestial navigation system. *(Photo courtesy of U.S. Navy)*