Navy Flies Drones Without GPS, Lands Autonomously on Moving Ships

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NAVAL AIR WARFARE CENTER AIRCRAFT DIVISION, PATUXENT RIVER, Md. — The Naval Air Warfare Center Aircraft Division (NAWCAD) successfully proved an unmanned system can navigate missions and land aboard Navy ships without GPS or pilot control.

“In contested areas where satellites and communications are jammed, autonomy gives significant advantage to our sailors,” said NAWCAD Commander Rear Adm. Todd Evans. “Breakthroughs like this help us scale unmanned capability fast and affordably across a distributed fleet.”

The live-flight demonstration proved that a tactical drone can fly mission tasks and execute recoveries on a pitching vessel at sea – even when satellite navigation is jammed or unavailable – by using its own commercial-standard cameras, motion sensors, and electronics.

“In a high-end maritime conflict, GPS is the first operational link an adversary attempts to sever,” said NAWCAD aerospace engineer Peter Arslanian. “By developing a modular adaptable system and putting it directly onto a UAS, we expand where and how the fleet can deploy unmanned systems with a simple software upgrade rather than expensive modifications to space-constrained ships.”

Traditional UAS landings rely on multimillion-dollar radar systems, recovery gear for the flight deck, and ship modifications that can take months to install. NAWCAD’s software-driven approach replaces that hardware by pairing an unmanned system’s mission sensors such as cameras with advanced guidance, navigation, and control software developed by the warfare center’s Maritime Autonomous Guidance-Navigation-Control Intelligent Coupled Systems Lab.

In flight, the UAS uses its camera to recognize a ship’s shape and visual cues to guide its flight path like a human pilot, while its guidance and control algorithms predict the ship's rising and falling deck in real time so the aircraft can touch down smoothly. The software works with nearly any UAS computer hardware and can scale across unmanned systems of all sizes, from small tactical quadcopters to large, combat-class aircraft.

With initial flight demonstrations complete, the software is ready for operational testing on fleet platforms. NAWCAD plans to scale the technology to larger unmanned systems, including tactical resupply drones, and is working with program offices to transition the capability into acquisition pipelines at the Navy’s Small Tactical Unmanned Aircraft Systems program office, the Collaborative Combat Aircraft program, and DARPA’s EVADE project.

The project was funded through the Naval Innovative Science and Engineering Program and the Office of Naval Research.

NAWCAD employs military, civilian, and contract personnel to operate test ranges, laboratories, and aircraft in support of test, evaluation, research, development, and sustainment for all Navy and Marine Corps aviation platforms. Based in Patuxent River, Maryland, NAWCAD also has major sites in St. Inigoes, Maryland; Lakehurst, New Jersey; and Orlando, Florida.