

Trident Warrior 2011

Demonstrating cooperative autonomy in Navy unmanned systems

By Emily Doll - [October-December 2011](#)

In its ninth year of execution, Trident Warrior 2011 (TW11) lived up to its reputation for robust experimentation using complex real-world scenarios. TW experiments are designed to fast-track the introduction of new capabilities, innovative technologies, and tactics, techniques and procedures (TTPs) to aid maritime forces in the full range of warfare — air, land, sea and cyber.

Directed by U.S. Fleet Forces Command (USFF), TW11 featured at-sea experimentation of more than 50 critical maritime initiatives. Joining in TW11 were participants from USFF, U.S. 2nd Fleet and 5th Fleet, program executive offices, Navy systems commands, the Naval Postgraduate School, academic and industry partners, and multiple ships and aircraft from the U.S. Navy and Air Force. Multinational participants included Australia, Canada, New Zealand, the United Kingdom and France.

TW temporarily deployed advanced capabilities on ships to collect real-world performance data and feedback from fleet users during the underway experimentation period. Data collected throughout the experiment is provided to Navy decision makers as recommendations regarding future capability investments for the fleet. The main U.S. event began July 18 and concluded August 1.

On July 20, 2011, CHIPS staff took part in a demonstration of unmanned surface vehicles (USV) performing interdiction operations. The demo, led by Capt. Carl "Carlos" Conti, USFF director of fleet experimentation, was conducted in a 3,600-meter area off the shores of Fort Monroe, Va.

Any Vessel Can Be a USV

Full autonomous capabilities for a USV are portable to any maritime vehicle and are enabled by a multipurpose sensor system. Autonomous Maritime Navigation (AMN), sponsored by Naval Surface Warfare Center, Carderock Division (NSWCCD), has been in development since 2006. During Trident Warrior, four boats, performing as USVs, were used in a force protection mission experiment, utilizing the AMN "brain" to perform cooperative autonomous behaviors within oil platform force protection scenarios. The AMN brain is an adaption of the NASA Jet Propulsion Laboratory's Mars Rover autonomy software, used in its "Opportunity" and "Spirit" robots.

The USVs were programmed to protect a specific area by creating a diversion between the position they defend and a perceived threat.

The USVs were equipped with multiple sensors and could share their individual surface picture to intercept intruders based on their combined situational picture. AMN has the ability to employ "sliding" autonomy, where it can operate in either fully autonomous mode (independent of humans) or in remote control (human in the loop). The capability allows a command center to monitor multiple USVs simultaneously while letting them perform as intelligence, surveillance and reconnaissance (ISR) collectors and intruder interceptors with no human intervention.

Two of the boats that were used are government owned from NSWCCD, one USV is a Northrop Grumman 11-meterlong rigid hull inflatable boat, and the fourth boat is a commercial vessel from Textron/AAI Corp., called Common USV. The Office of Naval Research, Defense Advanced Research Projects Agency and Office of the Secretary of Defense are sponsors in USV development.

Another component of the experiment aimed to determine if the USVs can operate with unmanned underwater and air vehicles. Collision avoidance and maritime regulations are the next frontier the USVs are tackling; they are programmed to automatically sense and avoid obstacles.

Capt. Conti explained that the most surprising aspect of the advancing technology is the "cooperation" displayed between the USVs. In a similar experiment conducted last year in San Diego, two boats had faulty equipment, but the sensors on board allowed the boats to self-identify the failures, he said.

"One of the boat's radar was broken, and all of the other boats 'knew' that because the boat that had the broken element said, 'I'm broken.' In response, the other boats provided radar information to the crippled vessel. Likewise, another boat self-identified that one of its engines was disabled, and the other boats came to its rescue," Conti said. "They (USVs) did it all by themselves. To me that's very exciting when you have that kind of brain power on board these computers. It's revolutionary."



FORT MONROE, Va. (July 20, 2011) Autonomous Maritime Navigation 1 (AMN1) and Autonomous Maritime Navigation 2 (AMN2) patrol for intruders during Trident Warrior 2011. The experimental boat can operate autonomously or by remote. The Trident Warrior experiment, directed by U.S. Fleet Forces Command, temporarily deploys advanced capabilities on ships to collect real-world data and feedback during an underway experimentation period. U.S. Navy photo by Mass Communication Specialist Seaman Scott Youngblood.



VIRGINIA BEACH, Va. (July 20, 2011) Information Systems Technician 2nd Class Michael Smith, left, assigned to Riverine Squadron (RIVRON) 3, Operations Specialist 2nd Class Denise Sanders, assigned to Expeditionary Training Group, and Operations Specialist 1st Class Robert McGill, assigned to Navy Expeditionary Combat Command, test communications equipment during Trident Warrior 2011 at Joint Expeditionary Base Little Creek-Fort Story. Trident Warrior is an annual fleet experiment focusing on new technology. U.S. Navy photo by Mass Communication Specialist 2nd Class Steven Hoskins.

Related CHIPS Articles

JPEO JTRS Delivers SRW Telemetry Operations Waveform

Coming soon to a theater near you: VALIANT ANGEL

News From the Joint Program Executive Office Joint Tactical Radio System

USS Kauffman Participates in Multiple Multinational Maritime Exercises

Non-lethal Weapons

During the USV demonstration, NSWCCD's Guardian Fast Patrol Craft challenged the unmanned boats by entering a protected area. Using a long-range acoustic device (LRAD), one unmanned boat transmitted an oral warning through a loudspeaker cautioning the patrol craft that its intentions were unclear and it should not proceed.

Loudspeaker warnings, or acoustic hailing devices, optical distracters and other non-lethal systems are incredibly effective in extending the battlespace by increasing the distance between a Navy ship and suspect vessel. The warning buys the commanding officer precious distance and time to assess the intent of an approaching vessel.

Non-lethal capabilities enable operational forces to effectively deter potentially dangerous individuals at increased distances, stop suspicious vehicles or vessels, and render enemy assets inoperable with few or no unintended casualties.

"In another spiral we are going to look at other non-lethal weapons for the vehicles besides LRADs that include: dazzlers, louder noises, [and] flashbang grenades, like those the Special Forces guys use. You shoot a couple of those out there and then you really make your intentions clear," Conti said.

LRADs and other acoustic hailing devices, produce focused, directional sound beams that project attention-getting, highly irritating tones intended to deter or modify an individual's behavior. This capability assists warfighters in determining intent at a safe distance and can potentially deter an individual prior to escalating to lethal force.

Flashbang grenades temporarily neutralize the combat effectiveness of enemies by disorienting their senses. The flash of light momentarily activates all light sensitive cells in the eye, making vision impossible for approximately five seconds until the eye restores itself to its normal, unstimulated state. The incredibly loud blast produced by the grenade adds to its incapacitating properties by disturbing the fluid in the ear.

Within irregular warfare environments, non-lethal capabilities can be valuable in enabling warfighters to tailor their responses to complex, threatening situations more precisely and appropriately when reduction of civilian casualties is essential to mission accomplishment. In addition, use of non-lethal weapons may help avoid destruction of culturally significant structures, or critical infrastructure, such as oil platforms.

USV Development

Research programs are focused on developing mission-level autonomy, perception-guided maneuvers and unmanned surface behaviors in more complex environments. This effort involves developing high-reliability sense-and-avoid algorithms to conduct coordinated and cooperative operations between multiple USVs and to further the development of autonomous systems for real-world operational employment.

The command and control of the USVs varies from fully autonomous to remote control. If a threat persists beyond the initial warning to retreat, an operator in the control room has the power to gain control of the USV at any time and then release it back to its own control/mission when appropriate.

The obvious scenario that would require the control room to gain access of the USV through a man in the loop intervention would involve the deployment of non-lethal and lethal weapon assaults. The ability to use force against an enemy without concern for loss of human life is an incredible advantage of the USVs, said an enthusiastic Conti.

"You have an unmanned boat that may get damaged or even sink, but that's OK, we protected our guys from getting hurt — and that's a big part of this.

"Our mission is to make this unnerving, and if we can make an enemy think twice about coming anywhere near us because of technology like this then we are doing our job."

Visit Trident Warrior on Facebook at www.facebook.com/tridentwarrior.

Emily Doll is a computer scientist student who completed a summer internship at SPAWARSYSCEN Atlantic. CHIPS senior editor Sharon Anderson contributed to this article.

TAGS: [Emerging Tech](#), [InfoSharing](#), [Performance Measurement](#)

Q&A with Vice Adm. Robert S. "Bob" Harward, Deputy Commander, U.S. Joint Forces Command and Rear Adm. Dan W. Davenport, Director, Joint Concept Development and Experimentation Directorate (J9), U.S. Joint Forces Command

Related DON CIO Policy

Internet-Based Capabilities Guidance: Official Internet Posts

Internet-Based Capabilities Guidance: Unofficial Internet Posts

Guidelines for Secure Use of Social Media by Federal Departments and Agencies, v1.0

Web 2.0: Utilizing New Web Tools

