The gathering swarm

Boeing is applying swarm technology to unmanned vehicles

By Diane Stratman

There is strength—and wisdom—in numbers.

Swarming bees know this. So do birds that fly in flocks and fish that swim in schools. They all know instinctively that many coordinated individual actions produce far better results—for nest building, food gathering or defense against predators—than even the best solitary effort.

Autonomous unmanned aircraft could one day work together in a similar manner, thanks to technology being tested by Boeing Phantom Works with support from Boeing Research & Technology.

In flight trials conducted in July and September, Boeing tested swarm network technology developed by Johns Hopkins University's Applied Physics Laboratory (APL). It enables disparate unmanned aerial vehicles to work together as an intelligent group toward a common mission.

For the July tests, Boeing dispatched two different types of unmanned aerial vehicles, or UAVs, on a simulated reconnaissance mission over rugged terrain in Oregon. Two Insitu ScanEagles worked together with a Procerus Unicorn from APL to search a test area. The vehicles successfully mapped terrain, autonomously generated their own waypoints and sent data to ground teams.

"The tests were a critical milestone in UAV flight … and proved that unmanned aircraft can autonomously collaborate to perform a mission," said Gabriel Santander, Boeing Advanced Autonomous Networks program director.

It was the first time that fielded, battle-tested UAVs were autonomously swarmed in actual flight, he explained. Previously, swarming demos were limited to indoor labs using test vehicles or using a centralized controller. Also, this was the first time dissimilar UAVs were autonomously swarmed while working together with one another.

In September, using the same technology, Boeing and APL demonstrated a holistic intelligence, surveillance and reconnaissance "cloud" at Webster Field, Md., using a variety of unmanned platforms: seven unmanned aerial vehicles (including three ScanEagles), two unmanned surface vehicles, an unmanned underwater vehicle, an unmanned ground vehicle and an unattended ground sensor.

The objective was to task the cloud with no user effort beyond the assignment of general mission objectives.

Two significant demonstrations were conducted. The first was a simulated search for mine-like objects in the Potomac River. The unmanned underwater vehicle searched for and identified several and relayed that information to the unmanned surface vehicle, which then relayed it to a ScanEagle. The ScanEagle relayed it to the control station. In the second demonstration, a ScanEagle collaborated with both the unmanned ground vehicle and an unattended ground sensor, all searching a territory and sharing sensor data.

The key in these tests, Santander said, wasn't getting similar vehicles to work together. It was getting disparate vehicles to work together.

This is critical, as there's a growing likelihood that unmanned aerial vehicles will play a primary reconnaissance role in disaster and war zones for search-and-rescue missions or early identification of threats, Santander said. As disparate unmanned platforms are dispatched for missions, it's likely they will have very little in common, particularly hardware. But, they will have to work together, so a common communications system will be necessary.

That's the role of swarm technology.

"Interoperability is one of the greatest challenges—and brightest opportunities—in the unmanned systems industry," said Debbie Rub, vice president and general manager of Missiles and Unmanned Airborne Systems. "Through innovative approaches, such as the swarm exercise, Boeing is taking that challenge head-on, leading us closer to an infinite range of possibilities for unmanned platforms."

Prior to this project, the technology had never been tested on military-grade platforms, only on research-grade ones.

In the July test, three UAVs were deployed. In September, 12 unmanned platforms were deployed. Ultimately, in a real-world reconnaissance mission, according to Santander, a more robust system comprising scores of unmanned vehicles could be launched and will have to communicate and work together.

"The technology has worked surprisingly well," said ScanEagle operator Adam Stock. "The autonomous behavior of the platforms has been smooth, predictable and intelligent."

Tests in 2012 will showcase the technology to potential customers. ■

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