Navy, MIT Grapple With Managing Drones On Dangerous Decks
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Carl Johnson, a Northrop vice president, seconds that assessment. "If I can find a safe and effective way to [autonomously] land on a carrier, why would I adjust the movements of other 'bots.

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laser scanners, radars, cameras, mapping algorithms and gesture and voice recognition software to enable partially or fully robotic ground vehicles. Much of that tech was tested out in the Grand Challenge and Urban Challenge robot races hosted by the Defense Advanced Research Projects Agency (DARPA) in 2005 and 2007, respectively.

As controls get simpler, the machines themselves need to be smarter and more autonomous. A host of companies -- including Google -- are refining the laser scanners, radars, cameras, mapping algorithms and gesture and voice recognition software to enable partially or fully robotic ground vehicles. Much of that tech was tested out in the Grand Challenge and Urban Challenge robot races hosted by the Defense Advanced Research Projects Agency (DARPA) in 2005 and 2007, respectively.

Traffic Control In parallel with the efforts at Edwards and Pax River, a team at the Massachusetts Institute of Technology has been working hard on a carrier-compatible human-machine interface. In 2009 the Office of Naval Research awarded an MIT team a five-year grant to develop the so-called Deck Operations Course of Action Planner, or DCAP, which the Navy said "will provide flight deck personnel with automated planning tools, enhanced information displays, and new user interface approaches that make it much easier to interact with autonomous systems." DCAP fits Sailors, deck vehicles and aircraft -- both manned and robotic -- radio tags. A computerized artificial intelligence tracks the location of the people and hardware plus the fuel and maintenance statuses of the aircraft and the material condition of the carrier's launch and recovery equipment. The AI knows the drones on the deck and clears them for takeoff and landing in coordination with manned planes.

The key to DCAP is a suite of sophisticated software algorithms that can quickly shift a complex deck schedule to accommodate human errors by the deck crew and mechanical failures on the part of the planes or ship. "How to build a full schedule quickly that can compensate for failures ... is something people cannot do very well," Jason Ryan, an MIT PhD student, said in a university news release. "But that's something that algorithms are exceptional at."

DCAP is deliberately not designed to be fully automated -- and for good reason. "We don't know a lot about how to tell a machine how to handle surprises," Randall Davis, an MIT professor, tells AOL Defense.

When a snag occurs that the DCAP system does not believe it can safely resolve, it alerts a human operator and prompts them to make a decision. The operator can override the system based on intuition. If, for instance, a pilot with a reputation for missing the arrestor wire appears on the landing schedule, the operator may move him higher up in the landing queue to give them more time, according to MIT. "That's something that's hard to program into systems, but it's something that a human can look at and understand," Ryan explained.

In just last year MIT conducted what ONR called a "successful live demonstration" of the DCAP on a scale model of a carrier deck, with 10 small wheeled robots standing in for X-47B-style drones. But the demo did not fully reflect the complexity of an active carrier deck, which can include many more people, vehicles and aircraft than were represented at MIT. An operational version of the DCAP will probably require even better AI with more safeguards.

Teamwork While the Navy has not publicly released the exact requirements it needs for an operational deck-handling system, it's possible to speculate based on existing research initiatives. Safeguards could include sensors and algorithms installed in the drones themselves plus tablet-style robot controls for deck crew.

MIT professor Missy Cummings, who has worked on several military programs including DCAP, is also developing a tablet interface for Navy helicopter drones that could wind its way into a deck-handling system. The tablet design reflects Cummings' philosophy that human-machine interfaces should be as simple and intuitive as possible -- like a video game. "The best technologies can't work if they can't work with people," Cummings tells AOL Defense, speaking strictly in her capacity as an MIT professor. (In other words, she's not speaking for the Navy.) Robot users need to "get to the point where UAVs can be operated by people with minimal training," she adds.

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Under the leadership of Sebastian Thrun, a veteran of the DARPA races, Google has been testing a fleet of seven semi-autonomous compact cars, and has even been certified to drive them on a routine basis in Nevada. There are obvious applications for pilotless aircraft that must operate from crowded airports or carrier decks, which Cummings says represent "chokepoints" in robot usage. With these technologies installed, naval drones in a deck environment could make decisions all on their own about where to go and when, subject to override by human crews with control tablets. An operational DCAP and its own human overseers could watch over and coordinate all of this decision-making and interfere with low-level decisions only when necessary.

For instance, a deck-qualified X-47B, having just landed according to the DCAP's schedule, could autonomously taxi from the arrestor wire towards a corner of the deck for parking again, following the DCAP's direction. But if the X-47B onboard laser scanner senses someone or something in its way -- say, a wandering Sailor or misplaced piece of deck equipment -- the robot will make the decision on its own to halt. A human spotter could then override the stopped X-47B and, using the tablet's touchpad screen, steer the drone around the obstacle to its parking spot. The DCAP would note the change and adjust the movements of other 'bots.

Cummings says robot ground-handling technologies, derived in part from other military and civilian systems, could then go on to find countless applications in both the government and private sectors. Factories and the trucking industry are possible beneficiaries, according to MIT.

Carl Johnson, a Northrop vice president, seconds that assessment. "If I can find a safe and effective way to [autonomously] land on a carrier ... why would I do it on just unmanned airplanes?" Johnson told AOL Defense last year. "It's a great technological game-changer that will affect everybody."

Most importantly, it will affect the Sailors who daily put themselves in harm's way on 4.5 acres of deadly carrier-deck real estate.