Debate Continues Over Role of Simulators in UAS Pilot Training

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By Dan Parsons

The Predator Mission Aircrew Training System

The Air Force now trains more unmanned aerial systems pilots than bomber and fighter pilots combined, signaling a deepening dependence on the capabilities those machines provide the military. Unmanned aircraft are becoming just as ubiquitous in other services, with hundreds of soldiers, sailors and Marines learning to fly them each year.

But there still is no agreed upon method of training new UAS pilots - and keeping seasoned operators proficient - for future conflicts where U.S. drones will be flying in contested airspace.

Officials are puzzling out the appropriate combination of traditional flight training, immersive simulators and practice on operational unmanned aircraft that would constitute a standardized regimen to teach and maintain UAS pilot proficiency.

Some officials say new pilots can be trained in the virtual world alone, or nearly so. But technology will not yet allow a seamless transition to the real world, said Karl Purdy manager of new unmanned aerial systems programs for Northrop Grumman.

"The answer that most of industry will give you is . that a simulator is the 100 percent solution" for training drone pilots, he said. "I would say it absolutely is not, at least not yet. In five years, maybe."

The Defense Department's Unmanned Systems Integrated Roadmap calls for an expanded reliance on simulators in the future as a cost-saving strategy and to speed up the certification of new pilots. It also emphasizes the need to iron out a formal training plan for unmanned systems operators, but paints a vague picture of how to achieve that goal.

"The current state of unmanned systems training is still very much a work in progress," it states. "As forces draw down in theater and redeploy, the services will require comprehensive continuation and joint-forces training in the peacetime environment. Failure to prepare for this eventuality will result in a loss of combat-gained experience."

In the Air Force, there are two types of potential UAS pilots in the pipeline - those who are trained manned-aircraft pilots and those learning from the outset to fly remotely piloted aircraft.

Veteran pilots transitioning to UASs can have 2,000 to 3,000 flight hours and habits learned over a decade-long flying career. Pilots' brains are hard-wired to perform certain actions in high-stress scenarios and have to be retrained, Purdy said. They require a specialized curriculum to make the leap from cockpit to control station, he said.

"When you get into a bind, you tend to go back to those old habits. There's a lot of habits we need to break if we want to turn a jet pilot into a UAS pilot," he said. "The students who have not had flight training at all, you can say in some aspects they are a better client to train as UAS pilots because all of those ingrained behaviors don't have to be broken and re-taught."

Rookie pilots receive a minimum of 20 hours of basic flight training in a Diamond 20 aircraft before transitioning to UAS. The Army, which operates smaller aircraft, sends fresh, high-school-age recruits straight into UAS training without any actual flight experience. Most Army unmanned aircraft take off and land autonomously, taking the burden of those operations from pilots. In the Air Force's unmanned fleet, only the Global Hawk is capable of autonomous takeoff and landing.

While some simulators boast high functional fidelity, they cannot realistically replicate the aircraft or how it responds to environmental phenomenon, Purdy said. In a UAS, aeronautical incidents like "ground effects" must be communicated to the pilot with gauges and alerts. When an aircraft flies within a full wingspan of the ground, it behaves differently. Simulators still cannot replicate that phenomenon, Purdy said.

Jeff Schram, director of business development at simulator manufacturer L-3 Link, disagrees. He said virtual training is uniquely suited for UAS pilots.

"The major advantage with unmanned simulators is we can make the unmanned simulator exactly like what the pilot will experience while he is flying the aircraft. We can recreate exactly the room, the controls, the displays, everything," Schram said. "With a manned aircraft you have to simulate all of the stuff outside the windows and the special relationship of the aircraft to the ground and other objects. That is very difficult to do with high fidelity."

The Air Force already owns 20 Predator Mission Aircrew Training System (PMATS) simulators made by L-3 Link. They were bought following a surge in demand for intelligence, surveillance and reconnaissance aircraft at the outset of the war in Afghanistan.

Predator drones and other UASs were rushed to the battlefield, as were the pilots to fly them. As a result, high-value unmanned systems crashed in training and on missions. The loss of aircraft inspired a parallel demand for training simulators.

The Army took advantage of simulators to train Gray Eagle UAS maintainers. L-3 Link builds a system that blends hands-on, wrench-turning experience with virtual training. Recognizing that several military services are teaming manned with unmanned aircraft, the company funded the development of a simulator that merges two Kiowa Warrior scout helicopters with a Shadow UAS ground control station. The Army is leasing the system to train helicopter pilots, Schram said.

The Navy plans to use simulators to train pilots for most of its future unmanned systems, including the Fire Scout helicopter, broad area maritime surveillance and unmanned carrier-launched aircraft. The Army and Marine Corps share the UAS Training Center at Fort Huachuca, Ariz., where they combine classroom instruction and simulation to certify pilots.

The growing need for new unmanned aircraft and the increasing systems capability will require expanded investment in simulators to train pilots, the UAS roadmap said. "This expansion will need improved simulation fidelity and integration with live platforms for both effective [and] efficient use of resources. This will require improvements in training environments and classroom courseware."
The Air Force doubled down on its commitment to PMATS in June when it awarded L-3 Link a seven-year contract extension and an option to purchase another 50 simulators. The Air Force certifies virtual trainers every few years in an effort to measure how much a student can learn using the system versus real-world experience. PMATS has been certified for more than 90 percent of flight training, but is actually used for about 55 percent of a student's required flight hours. That percentage - and reliance on simulators as a whole - could increase as training moves from overseas to stateside bases.

When unmanned aircraft are brought home from Afghanistan, there will be a glut of drones flying in airspace that is already congested with commercial air traffic, Purdy said.

Until the Federal Aviation Administration opens the national airspace to UASs, flights will be restricted to military bases. Too many drones flying in a confined space produces "bleed over" of their control signals and sensor data, Purdy said. That is not a problem in Afghanistan, where airspace is abundant and high-performance drones operate via satellite data links that are immune to such interference.

All of the unmanned aircraft assigned to Creech Air Force Base, Nev., will have to share the airspace over that base when they return from war, for instance. Though Creech is a huge swath of desert, the space will quickly become overcrowded with drones and their crisscrossing signals, Purdy said.

"As we saturate the skies with more and more UASs, especially when commercial flights are authorized by the FAA, it's only going to get worse."

Another major hurdle to standardizing the military's approach to UAS pilot training is the rapid proliferation of the systems themselves. They range from the size of a commercial jetliner to that of a shoebox. Some can take off and land on their own and others cannot. Some stay aloft for days and some for a matter of minutes.

There are as many control systems as there are unmanned aircraft.

The best way to replicate flying a high-performance Predator or Reaper is with a surrogate that mimics the controls but is far less expensive, Purdy said.

System replication fidelity requires that an actual aircraft be tethered to the controls on which UAS pilots are trained, he said. Using a surrogate drone like Northrop's SandShark would avoid risk to expensive operational aircraft and free up Predators and Reapers for operational use, he said. SandShark is a remotely piloted aircraft designed specifically to train UAS pilots for the commercial and defense markets.

The SandShark or another surrogate aircraft would not necessarily replace operational training in an actual Predator or Reaper, Purdy said. It would help a pilot maintain proficiency and develop skills prior to taking control of an expensive operational drone at less than the cost of a simulator, he said.

A simulator can cost $1.5 million per unit. Most medium-altitude, long-endurance UASs cost at least $3 million. The 2013 flyaway cost for a Reaper drone is just under $17 million. Surrogate aircraft, on the other hand, can be used for training at a fraction of the cost and more frequently, Purdy said.

Northrop does not intend to sell the SandShark. Instead, it plans to lease the aircraft to military trainers at airfields throughout the country on a fee-for-service, contractor-owned, contractor-operated basis.

"If you give me one hour of Reaper touch-and-go dollars, I'll give you 10 on the SandShark," Purdy said. "It does 50 landings per hour whereas a Reaper can do between 10 and 12 per hour."

"If you scratch the tail on a Reaper, you're talking hundreds of thousands of dollars in damage. If a student crashes a SandShark, it costs the Air Force zero," he added.

Purdy warned that while the SandShark is ideal for learning to operate a UAS during takeoff, flight and landing, surrogate drones are not ideal for mission-specific training. To train pilots and sensor operators to track terrorists and deploy ordnance, he said, a simulator is the way to go.

"For mission-related stuff, you can't beat a simulator. The graphics aren't perfect yet, but when you are training for missions, close enough is good enough. That's not so much the case with taking off and landing an airplane."

As simulation technology progresses, the complexity and authenticity of the virtual environments and scenarios will increase, Schram said.

"You have to make sure the student thinks he's flying the vehicle and not controlling the simulator," Schram said. "The UAS [simulators] will get there prior to manned aircraft. If we get the world environment right, then the simulation of flying through it will follow fairly quickly."

Ideally, the effect of environmental factors like topography and the actions of other entities, like other aircraft or enemies on the ground, will be unscripted and indistinguishable from real life, he said.

"Ultimately, there will be role-players that don't sound like droids. It's going to get a lot more fluid and more difficult to detect whether you're talking to a computer or a person," Schram said.

Photo Credit: L-3 Link, Northrop Grumman

Reader Comments

Re: Debate Continues Over Role of Simulators in UAS Pilot Training

This is article is quite misleading about a number of issues, but in some respects this is typical of the UAV industry and the abundance of vendors and sales pitches. First of all, while the operations near the ground are certainly critical for Air Force UAV operators and the need to train for this is key, the belief that this portion of the flight envelope can't be properly simulated is just wrong. One only has to look at the other branches of the military and civil training operations to see that they regularly train with very high fidelity in the take off and landing phases, with full modeling of ground effect, and any atmospheric interactions in these conditions, including wind shear, icing, microbursts, etc. Further, this is done with full validation of the simulation models against vehicle behavior and performance. This can certainly be done for UAVs, it will require flight models of improved sophistication from what is used now, but honestly, these configurations are not that aerodynamically challenging when compared to the modelling of ground effects of a 737 with multi element training edge flaps, full leading edge flaps, etc.
Finally, the notion of using another aircraft to train any part of the envelope of a much larger vehicle with a different planform, different inertias, different aerodynamics and control system with different capabilities and limits seems tenuous at best. While you might be able to use something like this for UAV ab initio training, the notion that a totally dissimilar aircraft could be used to train someone for a Predator’s landing behavior would seem to invite negative training at best, potentially something much worse. The article does not say what the SandShark’s characteristics are, i.e., is it inertially scaled, is it’s control system devised to replicate the performance and limitations of the replicated vehicle, etc. And finally if you’re worried about ground effect, how will the modeling of that with a surrogate training vehicle with a totally different span ultimately help that situation, given that a vehicle’s ground effects is fully dependant on it’s wing span?

John Ralston on 11/26/2013 at 12:44

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