HARVARD NATIONAL SECURITY JOURNAL FORUM

Unmanned Robotics & New Warfare: A Pilot/Professor's Perspective

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As the director of the Massachusetts Institute of Technology's Humans and Automation Laboratory, I was asked to comment from a technologist's perspective at the recent symposium Drone Warfare: New Robotics & Targeted Killings, on the panel, "Unmanned Robotics & New Warfare."† My perspective is unique in that not only do I conduct millions of dollars of research in the development of technologies to enable one or more humans to control unmanned vehicles (i.e., robots) more easily, but I also look at these issues from the perspective of having flown advanced fighters in the U.S. Navy, namely the F/A-18 Hornet.

While there are many forms of unmanned vehicles in use in the military today (unmanned aerial vehicles (UAVs), unmanned ground vehicles (UGVs), underwater unmanned vehicles (UUVs), etc.), my comments will focus primarily on UAVs because they are currently used to perform targeted killings. However, it should be noted that unmanned vehicles of all types could be expected to do the same at some point in the future.

The term "control" is a misnomer when discussing UAV control because, in most settings, human operators "supervise" the control of a UAV as opposed to directly or manually controlling it. The distinction between supervisory and manual UAV control is critical. Supervisory control is intermittent human interaction with automated systems using high-level knowledge-based cognitive processes such as judgment and experience, whereas manual control occurs through human skill-based direct vehicle manipulation, e.g., a pilot flying a plane with a stick and rudder. In supervisory control, humans are more on the loop than in the loop.

It is precisely this move from manual to supervisory control for UAVs that has caused and will continue to cause ripples throughout the military because the basic skills once required of manned aircraft pilots are no longer needed. UAV control today is effectively a "click and point" paradigm, so any person familiar with a basic PC or Mac® can be a UAV "pilot". Indeed, in my laboratory, we recently conducted formal studies demonstrating that with just three minutes of training people with no experience flying UAVs can effectively use an iPhone® to control a

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† A full video recording of the Symposium can be found on the Symposium page of the Harvard National Security Journal website: http://www.harvardnsj.com/symposium.

UAV carrying a webcam. These novices could manipulate the system with such precision that many could read the 20/30 line of an eye chart through the UAV's webcam.

Automation has advanced to such a degree that pilot stick-and-rudder skills are no longer needed in UAV applications. Due to this advancement, the U.S. Army can train UAV operators to "fly" a UAV in about 10 weeks. However, in a clear attempt to uphold a pilot-centric culture, the Air Force still requires two years of pilot training to control the exact same vehicles with the exact same capabilities. The primary difference between the two services is that Air Force pilots are allowed to "fly" the vehicles through joystick actions, while Army operators literally command their vehicles through point and click interactions. Unfortunately, temporal latencies inherent in remote control of UAVs like those of U.S. Air Force Predators mean that pilots who try to manually fly UAVs introduce significantly greater risk in operations: roughly half of all Predator accidents are due to pilot error. As a result, the Air Force has recently mandated that all take-offs and landings must be fully automated. The Army has adhered to this policy from the beginning of its UAV operations.

While UAV control can be a cognitively "easy" task, overall UAV operations are by no means easy. These operations have introduced a number of complex interactions that require significantly more coordination across several agencies, including de-confliction with manned aircraft. In addition, the use of UAV full-motion video and other sources that provide information from both manned and unmanned vehicles in near real-time has overloaded decision makers. The massive influx of electronic data from a wide array of sensors has literally left the U.S. military drowning in data. How to distill the voluminous amount of information available in real-time to aid decision-makers in critical life-or-death decisions is still an open area of research and development, and the problem only promises to get worse before it gets better.

The possible moral, legal, and ethical implications of unmanned technologies are many, and I will discuss just a few that are specific to my area of expertise. First, while UAVs have not really changed how warfare is conducted in terms of targeted killings (i.e., we search, then detect, then kill), the remote and nearly constant presence of UAVs has significantly shortened what is known as the "kill chain". Prior to UAVs and the electronic networks that accompany them, finding, identifying, and then authorizing the use of deadly force against a suspected enemy often took days or even weeks to accomplish. Now, these same processes occur in a matter of minutes or maybe hours. Given these compressed time schedules and the well-documented ability of people to more readily engage in the use of deadly force at a distance (a phenomenon I describe as a "moral buffer"), as well as the relatively ease of UAV control that I previously discussed, it is quite possible that we could engage in more deadly interactions without the necessary time to reflect that older airborne-based systems inherently provided. However, it is also possible that the networks of information and the near real-time interconnectivity of decision-makers could allow us to engage in safer, more ethical engagements because lawyers, politicians, and military leadership can literally all see the same video feed at the same time and come to consensus about the "right" decision to make.

Lastly, while the focus of this Symposium was the use of unmanned technologies for targeted killings, one social impact rarely addressed that I feel will be much more compelling in years to come is the use of these technologies for acts beyond those of targeted killings. Given that almost anyone can now control a UAV with their iPhone®, it does not take a MIT futurist to imagine a scenario where such technologies could be used in terrorist acts both overseas and on U.S. soil. For example, a small UAV could easily be flown into any sports stadium loaded with a deadly biological agent. Such technologies may also be used in many more insidious ways, such as monitoring a point or person of interest, as these platforms are effectively mobile cameras that can transmit over a network. Privacy could be redefined dramatically given the future ability of a UAV (or a bug-sized UGV) to follow you almost anywhere and transmit your every action over the Internet.