Ethical Considerations of Autonomous Aircraft

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Introduction

With the advent of recent technologies unmanned aerial vehicles or UAV's have become a mainstay of modern air warfare, but research and development has pushed the envelope even further to make them totally autonomous. Although it may seem like the next step in the evolution of these types of aircraft it presents several unique problems that must be considered before they become operational and deployed. The most thought provoking of them all are the ethical considerations of a machine that will analyze the situation and then through its programming decide to take action and engage a target either in the air on the ground. Some in the military are for this because it will reduce that amount of resources needed to support an aircraft of this type while others are appalled that a machine would be allowed to make decisions concerning life and death.

A Brief History of UAV's

Unmanned aerial vehicles have been in existence as long as aviation but their development has been much slower. The technologies of the time were the biggest limiting factors in their abilities. Edward Sperry, the same man that invented the gyroscopes for ships, would change that. In 1909 he developed the first gyroscope for aircraft but it was heavy and did not perform well in the three dimensional environment of flight. He solved this problem in 1911 by reducing their size and attaching them to the flight controls. Sperry then proved the concept in June of 1914 in Paris where his son flew a Curtiss seaplane and demonstrated that stabilizing abilities of the invention by having his mechanic wing walk while taking his hands off of the controls. His invention won the Collier Trophy in 1914 for achievement in aviation. (Newcome, 2004)

The U.S. Navy took interest in Sperry's invention and in 1917 offered him a contract to develop what it called an "aerial torpedo". Development was plagued by failures, mostly caused by the limiting factors of the technology of his time. The first successful launch and recovery occurred in March of 1918. There were several problems that had to be overcome and one of them happened during the launching of the aircraft and this was solved by none other than Carl Norden, developer of the Norden bomb sight. By changing the design of the catapult system it prevented the upsetting the gyros during launch. But the success of the catapult and the end of WWI would relegate the flying torpedo to target drone status. The following sums it nicely:

After the last prototype torpedo was expended, flight tests resumed with the N-9, and on its first launch with Norden's catapult on 17 October 1918, the now-unmanned seaplane launched without a problem, flew straight and level, and when its distance gear failed at the planned 14,500-yd mark (8 miles), continued on course out to sea at 4000 ft, never to be seen again. With the N-9's disappearance over the horizon and the armistice at hand, the roles of Sperry and Hewitt in the development of unmanned aviation came to a close. (Newcome, 2004)

Their best success was also the undoing of any more research into UAV's in the early age of aviation. Programs continued along by other nations with some success but the real advances would come during WWII with the development of rudimentary remote control and better gyroscopes. Although attempts at remote controlled weapons by the Allies during the war had very few successes the Germans took a different route and pioneered it with the V1, which was essentially the first fire and forget cruise missile. Development continued after the war in many different nations but the real successes came with the use of miniaturized electronics and then solid state circuitry.

Where We Are At Now

The media has been inundated with images of UAV’s doing surveillance and of course the most popular one that everyone recognizes is the General Atomics Predator and its armed cousin the Reaper. These aircraft although remotely piloted are not autonomous. The first truly autonomous flight was done by the Northrup Grumman Global Hawk in 2000 where it flew from California to Australia without human intervention from takeoff to landing in 23 hours. (U.S.Air Force) Since then advancements have been made in both software and hardware that has allowed the Boeing X47-B to be developed which is a truly autonomous aircraft and this is changing the way we think about combat aircraft.

Removing the Human Decision Maker

Removing the pilot from the aircraft has been the holy grail of the Air Force. By doing so it reduces the complexity of the vehicle while increasing its capabilities by allowing it to withstand forces and do maneuvers it could not do with a human pilot on board. Attrition is also contributing to the drive for autonomous combat aircraft. A shortage of pilots has gotten so bad in the U.S. Air Force that they are actually offering higher wages and larger retention bonuses just to keep them in. (Hennigan, 2013) This only exacerbates the problem and will prove the case for the use of autonomous aircraft. Remotely piloted aircraft accounted for one of the largest expansions in aircraft weaponry in the U.S. “Drones went from being a handful of aircraft on Sept. 11 to the "fastest growing part of the force," said Peter W. Singer, author of "Wired for War," a book about robotic warfare.” (Hennigan, 2013) The costs savings are also a contributing factor in the spread of UAV’s, there is no doubt that it costs millions of dollars to train and then maintain a human fighter pilot but all of those expenses can be eliminated with the use of drones.

Legal considerations

According to Article 48 of the Protocol Additional of the Geneva Convention “Parties to the conflict shall at all times distinguish between the civilian population and combatants and between civilian objects and military objectives and accordingly shall direct their operations only against military objectives.” (Sarah Kreps, 2012) But there is a serious problem because currently there is no system available today that can distinguish friend from foe. Remotely targeting of individuals in the theatre of war has become such a concern to the Red Cross that they printed an article by William Boothby who is the retired Deputy Director of legal services for the Royal Air Force where he stated “So far as is known, technology is not currently available to support the autonomous distinguishing of military personnel from civilians” and then later in the same paragraph continues with “The author is not aware of any such system yet having been fielded, and therefore concludes that autonomous attack of personnel can, for the time being at least, be excluded on the ground that the rules as to precautions in attack cannot be complied with” (Boothby, 2012).

There is a large amount of debate over the legality of piloted drone strikes which will only be compounded when machines take over the decision making process. If a drone pilot makes a mistake they may actually be subject to sanctions for not verifying their targets before taking actions, but buy allowing computers to make the decisions it will essentially absolve the operating government of any responsibility for the drones actions, a sort of free pass because the operating authority could just blame on it on the software in case any mistakes were made in the identification of the target. When mistakes have been made by human operators the victims or their relatives have been compensated by cash payments such as happened in Yemen where a wedding party was mistaken for an Al Qaeda convoy. (Miller, 2014)

Limiting theatre of operations

The only way to prevent the misidentification of targets by automated systems is to limit the area of operations of the aircraft to areas of known hostile activity. But the identification of targets must be backed up by humans and only then will they be allowed to take action. For example, during the first Gulf War Baghdad had a considerable amount of AA (Anti-Aircraft) coverage that put coalition pilots in a great amount of danger to the point where the commanders decided to use the recently unveiled F-117 to take out the command and control centers for the AA batteries. They were successful but if the drone technology had been more advanced back then, they could have used those instead of the stealth platforms that were exponentially more expensive.

By using the autonomous aircraft with a predetermined mission profile already programmed it will prevent the prospect of collateral damage to non-combatants. Ballistic missile will have the targeting data already programmed in before they launch and so should the robotic aircraft. Instead of allowing them free reign to change the scope of their mission mid-flight they should have strict rules of operation with primary and follow up targets already decided upon and when those are gone be directed to immediately return to base. By limiting the ability to operate autonomously it will prevent the chance of a misidentification of targets and ensure they operate within the guidelines of the Geneva Convention even if the enemy does not. As has already been seen in the war against terror when an armed UAV makes a mistake and causes casualties of innocent bystanders the news media will broadcast it for all to see in an attempt to say “See I told you drones were bad” while hardly mentioning their success in the field because it does not fit the narrative they have already chosen for UAV’s.

Loss of Control What If?

On December 4th of 2011 a CIA controlled RQ-170 was supposedly commandeered by Iranian military forces through a hacking of the GPS system (Scott Peterson, 2011). If this was true and not just a propaganda campaign because they came across the wreckage of a downed drone, then the implications are staggering. Autonomous aircraft must have a link with the command and control structure to direct the aircraft in case of any changes in the missions or if something goes wrong. The exploitation of that link could cause loss of control and redirection of the aircraft against friendly forces or even civilian targets. If these aircraft were deployed domestically for border surveillance then they could be redirected to disrupt commercial air traffic or many other nefarious actions.

Another consideration is if its targeting commands become corrupted and then if used domestically civilian air traffic may be identified as a threat and the aircraft will take action against that threat according to its mission. The results could be catastrophic, as almost all passenger aircraft do not have defenses against airborne weapons. The ATC system in the CONUS is also not configured to handle autonomous aircraft. The system currently operating in the U.S. is not what would be considered a high reliability system, furthermore the UAV's would need to accept commands from the controllers and act accordingly and the military will allow the ATC controllers any access because of security reasons. The loss of control of an armed autonomous aircraft in domestic airspace is one of the primary reasons they should remain unarmed and be relegated to surveillance duty only. I doubt the public would be willing to accept a robotic aircraft with the capability to take down passenger aircraft flying freely throughout U.S. airspace all in the name of security. It will only take mishap to shut down the entire program so it is better to err on the side of caution and keep those UAV's in domestic airspace unarmed.

Limiting Their Roles

As Boothby pointed out earlier, there is currently no system in service at the time that can determine with certainty between a viable human target and noncombatant. The roles of autonomous aircraft must be limited to surveillance only. This will prevent the unintentional discharge of ordinance because of a software malfunction or misidentification of target. By keeping them unarmed it will also make human interaction mandatory because it will have to alert an operator to an item of interest that will need further investigation. Once clarification is made by then the human element will decide what action to take as to either ignore or send in other personnel or direct it away from nearby air traffic.

Although surveillance is one role they can be limited to they could also be used to deliver cargo and supplies to front line encampments while not putting pilots in danger of fatigue while running resupply missions. Sikorsky has already done this with a modified UH-60 helicopter. Although the cost of the vehicle is much higher than the smaller UAV’s they are using an existing airframe that can haul much heavier loads while freeing up pilots (Metha, 2014). Of course the next evolution of a system like this would be in transport category aircraft and that would be to eliminate the pilot from commercial airlines, a concept the flying public would most likely never accept. Perhaps a more appropriate place for that technology would be the exclusive cargo airlines such as UPS and Fedex, since there would be no passengers to complain about the robotic pilot of the aircraft. Ultimately this would all be a moot point if the public does not accept them in domestic airspace, they already express concern over remotely piloted drones doing border and maritime patrol even though they are rarely used in those instances. Although rarely sighted because of the altitude they operate in there have several unconfirmed sightings of unarmed Predator drones patrolling the skies over New York and other cities.

Recommendations

There are many varied opinions on the use of autonomous aircraft both in the theatre of war for surveillance as well as taking out high value targets, as well as domestically for the use of homeland security. There is no doubt that advances in technology have made them cheaper and more reliable but there is still the human element involved. Taking the human out of the equation will drastically alter the way the public perceives them and put more pressure on the government to limit their operations to non-domestic use only. These aircraft must have the ability to be taken over by a human operator at any time. There must be fail safes installed to prevent the taking control of the UAV by a belligerent state such as the RQ-170 was rumored to have hijacked by Iran. If used domestically they must be limited to the role of surveillance only and must stay clear of established air corridors to prevent interaction with civilian air traffic.

It is only a matter of time before these systems will be installed in transport category aircraft so their use must be strictly limited to cargo aircraft only. In essence we already have it with Category III capable autopilots in the aircraft but there is still the human element ready and able to take control in case of an emergency. With autonomous aircraft that living backup system will not be available. Main and redundant systems must be a high reliability type with standards the same that NASA has for their systems. The system must accept commands from special ATC controllers trained specifically for autonomous aircraft, and there must be sufficient ground personnel available to take control of the aircraft remotely in case of an emergency to prevent interaction with human piloted civilian traffic. Self-driving cars have been in the news recently and it will only be a matter of time before the first truly autonomous aircraft put into service outside of the military so every precaution must be taken to protect human lives in the air and on the ground.

Conclusion

This paper started with a brief history of UAV's and how they have developed from military use to where that technology may be going in the future. Although there have been few discussions about the ethics and legality of autonomous aircraft as they have been concentrated on the use of RPV's or remotely piloted vehicles, there are still many ethical hurdles to be overcome before their use will be allowed in both combat instances as well as in the commercial aviation arena. Their cost may be too prohibitive and may only be borne by governments but as the technology advances and costs go down that may change. There is already a system in place called the Boeing Uninterruptable Autopilot System which is supposed to be a final failsafe to remotely pilot and land the plane in case of an emergency. "The "uninterruptible" autopilot would be activated – either by pilots, by onboard sensors, or even remotely via radio or satellite links by government agencies like the Central Intelligence Agency, if terrorists attempt to gain control of a flight deck." (Helton, 2014). A system such as this would need to be installed in every autonomous aircraft as a just in case measure.

Advances in technology do not stand still although at times it may seem that stagnation is the norm. Once the underlying technologies become reliable and economically feasible their use will proliferate at an ever expanding rate and autonomous aircraft are doing that. Their use will only expand because of cost and personnel reductions needed to maintain them as well as their endurance which is only limited by the fuel on board and the reliability of their systems.

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