SECTION VI
Military Technology

Unmanned Aerial Vehicles: Breaching New Frontiers

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The advent of Unmanned Aerial Vehicles (UAVs) changed the conduct of warfare forever. The aerial platform provided a new dimension due to its size which enabled a near zero detection capability, and being unmanned, its endurance potential provided the planners with continuous surveillance over the target area. Its widely increasing use in reconnaissance, airborne intelligence, and combat engagement has transformed the conduct of the air battle. With the passage of time, the humble UAV has leaped from simple missions to wider applications in the tactical, operational, and strategic environments wherein swarms of UAVs are being employed to target the enemy's defences with near autonomous functions, and newer ideas now allow a combination of UAVs to recce and engage potential targets while communicating with each other, with minimal interference from ground stations. The increasing use of UAVs as reusable weapon delivery platforms led to the development of counter

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technologies to decimate their threat. Some of the likely applications were discussed in the previous issue. This article will feature new advancements in UAVs and their employment, as well as developments in the neighbourhood.

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Smaller Unmanned Aerial Vehicles and Increasing Autonomy

One of the considerations for the UAV's ability to complete its mission is its size and speed. However, in the UAV, with sensor payload and weapons, the size increases and speed reduces, thus, making the platform susceptible to detection and engagement by enemy air or air defence systems. The technological edge of the major United States platforms such as the MQ-1 Predator and MQ-9 Reaper has been steadily eroded by Chinese UAVs which are cheaper and equally potent. The future application by the US Air Force lays greater emphasis on smaller platforms which can be transitioned into a strategic role while reducing the requirement of heavier platforms. The second focus is on greater autonomy to the smaller UAVs by moving from the concept of 'man in the loop' to 'man on the loop'. Thus, a package of smaller UAVs will communicate with each other, relay target information, provide protection to Unmanned Combat Aerial Vehicles (UCAVs) and execute a mission with minimal control of the ground station.[1] Another area of focus is the endurance and multiple launch and recovery system. With the requirement of increased endurance, newer fuel options including lightweight miniaturised solar cells are a viable option. Multiple launch options like air launch and ground or sea retrieval or a combination will provide extended range of the UAV and deployment options.[2] The third application is the integration of the UAV with the manned system, such as an armed helicopter, where the crew of the helicopter guides the UAV and harnesses its capability to engage targets.

Another concept under evaluation is the laser weapon equipped UAV, Lightning Strike. The UAV uses a hybrid electric distributed propulsion system and its turboshaft engine drives three generators, which produce three megawatts of electrical power.[3] The generated power is used to

Increased survivability, stealth technology, longer-range weapons and communications are focus areas for new UAVs.

vertically lift the UAV, and while in its cruise mode, it uses only one-third of the power and the balance is available as a laser weapon system. The UAV will have greater reliance on autonomy and Global Positioning System (GPS) independence so that it can pilot itself, but humans would still be in charge of deciding when to fire. General Atomics, the makers of the MQ-1 Predator and MQ-9 Reaper drones, are also undertaking a study to incorporate a 150-kilowatt laser into their large Predator C drone.

Newer Applications

Another interesting focus area is the development of the Aerial Reconfigurable Embedded System (ARES), being built by Lockheed Martin. The planned system is a 41-feet-long unmanned flying wing in a tilt-rotor configuration. Two ducted prop-rotors, about eight feet in diameter, embedded near a stubby fuselage, will swivel up to let the ARES take off and land like a helicopter and tilt forward to let it fly like an airplane.[4] The fuselage will be able to carry various plug-and-play payload modules like cargo, sensors, life support gear or weapons, and deliver them to troops in the battlefield. Planned to be flight tested in 2017next year, the system is likely to have a carrying capacity of 1,350 kilogram and an operating distance of approximately 300 kilometre. The other fields of focus by the planners are increased survivability by greater standoff distance, longer-range weapons and longer-range communications; stealth technologies to enable UAVs to operate in contested air space; increased onboard computing power so that only processed information is sent to the ground station; lower manufacturing, acquisition, and life-cycle operations and maintenance costs; multi-mission capabilities utilizing swappable or reprogrammable sensors to get more utility from each platform; sense and avoid sensors to enable the UAVs to operate in the near vicinity of manned systems; and common ground systems and joint coalition to reduce the number of installations and operators and make joint operations easier.

Counter Drone Systems

The increasing use of UAVs has led to the rapid development of counter-drone technologies. A number of counter-drone systems are working on the principle of jamming the radio signals and disabling the UAVs. In the latest developments, Russia has developed an advanced stealth robotic system capable of detecting reconnaissance and attack UAVs at a distance of 20 kilometre with an accuracy of 10 metre.[5] Weighing 20 kilogram, the non-emitting optical radar can be mounted on a track chassis or placed in a small truck for detection of UAVs. Due to its stealth characteristics, the radar has also been able to detect UAVs which were maintaining radio silence. Its non-emitting radiolocation feature is another promising trend in the development of modern radar systems. The United States efforts have significantly intensified after the Islamic State in Iraq and Syria (ISIS) used a commercially available drone and killed two Kurdish fighters near Erbil in Iraq on 2 October 2016. The Defence Advanced Research Projects Agency (DARPA) of the United States is researching on development of a mobile drone defence system that can defeat a raid by a swarm of UAVs on high value moving targets. Called the Mobile Force Protection programme, the project seeks to develop an anti-drone system against present and future autonomous UAVs. The US Army is also upgrading its AN/TPQ-53 air defence fire control radars to detect, classify, track and pinpoint enemy UAVs, and enable their standoff distance destruction.

Tracking the Drones

The security forces in future will be challenged by the need to quickly detect and identify small UAVs, especially in urban areas, where sight lines are limited and many objects may be moving at similar speeds. To achieve the technically difficult goal of mapping small UAVs in urban terrain, DARPA launched the Aerial Dragnet Programme, in September 2016 to seek innovative technologies to provide persistent, wide-area surveillance of all UAVs operating below 1,000 feet in a large city.[6] The Programme envisions the tracking system relying on a network of tower or drone-mounted 'surveillance nodes' scattered throughout the city. Using sensor technologies that can look over and between buildings, the surveillance

nodes would maintain UAV tracks even when the craft disappears around corners or behind objects. The output of the aerial dragnet system would be a continually updated picture of the air space at altitudes below which current aircraft surveillance systems can monitor and will be disseminated electronically to authorized users via secure data links. Another application in planning is of AT&T working in collaboration with the National Aeronautics and Space Administration (NASA) to develop an Unmanned Aircraft System Traffic Management programme to monitor drones. The Programme will make it safer for drone operators to plan and monitor flight paths, navigate drones, and use drones for surveillance. The main focus is to lower the risk of drone-related cyber attacks.[7] Another development which will benefit the foot soldier is the application to detect drones. Northrop Grumman has demonstrated a smartphone application to identify and detect Group 1 drones.[8] The application is an acoustic sensor that operates on Android cell phones and uses the phone's microphone to detect Group 1 drones.

Chinese Unmanned Aerial Vehicles

China has been engaged in research and production of a large number of reconnassiance and armed UAVs over the last two decades. It unveiled the prototype of its latest Cai Hong (CH) 5 UCAV at the 11th China International Aviation and Aerospace Exhibition at Zhuhai in November 2016. Capable of carrying 16 to 21 AR-1 air-to-ground missiles[9] or a smart bomb combination, it is China's most powerful UCAV, equipped with high-tech radar jammers (Plate 1). Developed by the China Aerospace Science and Technology Corporation, the CH-5 has a

wingspan of 68 feet and can carry a 1,200 kilogram payload. It can fly up to an altitude of 30,000 feet with a range of 6,500 kilometre and has an operating endurance of 60 hours.[10] The CH-5's programming and datalink allow its controllers to link with other UCAVs, like the CH-3 and CH-4, to conduct joint, multi-drone missions. The United States is developing the Predator C or the Avenger which has a 76-feet wingspan, can carry 1,600 kilogram of precision munitions and can operate up to 50,000 feet.

Other prominent UAVs on display during the exhibition were the Cloud Shadow UAV and CH-500. The Cloud Shadow is a turbojet powered High Altitude Long Endurance (HALE) UAV. The 9-metre-long UAV's stealthy features include a jet engine hidden from enemy radar by a serpentine air intake, serrated panel edges, canted vertical stabilisers, as well as a faceted nose (Plate 2).[11] Its six hardpoints can carry a combined payload of 400 kilogram, including a wide range of precision-guided munitions like the YJ-9E light cruise missile,[12] FT-7 satellite guided glide bomb, and anti-tank missiles.[12] The CH-500, on the other hand, is a co-axial rotary UCAV and can carry two HJ-10 anti-tank missiles. Its small size makes it suitable for employment by frontline battalion and company commanders.

Indian Efforts

The Indian UAV programme has had a chequered history. The Nishant UAV was not a success and the Defence Research and Development Organisation (DRDO) has been actively pursuing the development of the Rustom UAV. The first successful flight of the Rustom-II took

place in November 2016 at Chitradurga Flight Test Range. Rustom-II weighs 1.8 tons and will have a capacity payload of 350 kilogram. It has a wingspan of 21 metre and an endurance of more than 24 hours.[13] Rustom-II is a multi-mission UAV for the Intelligence, Surveillance and Reconnaissance (ISR) roles for the three armed forces. It is capable of carrying different combinations of payloads like the Medium Range Electro Optic (MREO), Long Range Electro Optic (LREO), Synthetic Aperture Radar (SAR), Electronic Intelligence (ELINT), Commercial Intelligence (COMINT) and Situational Awareness Payloads (SAP) to perform missions during day and night. India is also engaging the United States for the purchase of Predator UAVs for the armed and surveillance roles to bolster its aerial capabilities on both fronts.

Conclusion

UAVs are going to be the mainstay for global Armies in the coming decades. Newer applications and employment techniques will shape the conduct of the battlefield. As the use of drones increases in the battlefield, guides on their export are also necessary to curb their use by rebel regimes or groups. The United States sponsored the first ever Armed Drone Declaration in October 2016, which was signed by 45 countries. In the Indian neighbourhood, China has taken quantum leaps in UAV development. In the Zhuzai Air Show, it showcased a swarm drone attack by employing a group of UAVs to carry out multi-mode functions. India's priority must be to quickly acquire sizeable numbers to mitigate the Chinese threat while fast tracking indigenous capability enhancement by involving private sector defence firms.

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