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ELIMINATING CONTROL SURFACES: A NEW BENCHMARK IN AIRCRAFT DESIGN!

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The proliferation of drones for military and common use and revolution in drone technology has set the agenda in aviation industry. The next decade will see many innovative concepts like swarm UAVs and miniature drones taking shape and gaining acceptability in an under explored sector. The quest to make aircraft fly faster and undetected has an immense bearing for many innovations in this field of aviation.

In a recent innovation, BAE Systems (UK) and the University of Manchester, have flight tested a drone aircraft in September 2017 which does away with conventional flight controls for manoeuvring and instead uses jets of air to change direction. This makes the aircraft lighter, more manoeuvrable and requires less maintenance on the airframe. The absence of control surfaces also contributes to some amount of radar stealth, and hence could pave the way for stealthy drones in future.[1]

The drone – MAGMA concept craft – is said to work on a concept called 'Wing Circulation Control' (WCC). The technique essentially uses air tapped from the jet engine and blows it over the wings at high speeds to vary the airflow over the wings, thus producing varied amounts of lift. Differential airflow over the wings would thus give the effect caused by ailerons, and airflow at very high speeds blown over the wings at take-off and landing would give the effect of flaps and slats. Another innovative concept used is the 'Fluidic Thrust Vectoring' (FTV). In this, air jets are used to deflect the exhaust gases thus in effect deflecting the engine thrust vector thereby enabling a change in direction for the aircraft. Advantages of such systems are many. It not only eliminates the structurally weak points, i.e., the controls and their linkages, but it also reduces the weight of the aircraft, thus requiring lesser fuel and giving longer endurance and facilitates carrying more payloads on a drone. The thrust vectoring gives instantaneous change in direction which is a tactical advantage, especially in narrow passages like hills, and also does away with the complicated mechanics involved in installing hydraulics to move control surfaces.[2]

The ultimate aim of the new drone design seems to be to fly it at supersonic speeds and be stealthy. Though the concept appears novel, achieving stealth may take a little more than just doing away with moving control surfaces and body shaping. The jet engines are essential to achieve supersonic speeds but come with a penalty of higher noise. Hence, the acoustic signature could be a give away from miles. The stealthy design is aerodynamically unstable, and any malfunction of the jet engine will make the drone difficult to control. Moreover, an engine malfunction will also make the WCC and FTV ineffective, rendering the drone uncontrollable. Launch and recovery are the critical areas for any aircraft, and here too the Magma faces a severe drawback. This is because of the absence of flaps and slats which enable landing at slower speeds. The wind circulation even at very high speeds may not reduce the landing speed slow enough to be manually controlled. Hence, a very high level of automation would be required. These are probably just a few of the design challenges that need redressal. The concept of wing circulation control is not novel either. Such modifications of aerodynamic flow around the wing existed in third generation fighter aircraft like the MiG-21, Lockheed F-104 and Buccaneer, which had blown flaps. This is also not the first time that BAE Systems has tried its hands on a stealthy drone. In 2013, they flight tested a UCAV with stealth features called the 'Taranis'. The design was similar to the Magma.

What is clearly seen is a trend for drones and UCAVs becoming faster and stealthier. There have been occasions in the past when US drones have been claimed to have been shot down, e.g. Iran's claim in 2011[3]and Yemen's Houthi forces claim in October 2017[4]. The authenticity of these claims has never been made public, though it is known that such a possibility exists. The greater danger lies in the ability of adversary nations reverse engineering cutting-edge technologies used in such drones (as in the case of the RQ-170 Reaper 'shot down' by Iran in 2011). Speed may not necessarily be a boon for drones as they are meant to loiter in the hostile area and allow their payloads to do their job. Survival features were meant to be a priority for manned aircraft in the hostile area. Nevertheless, loss of aircraft affects the pace of an operation and mission reliability is a key factor to success in any operation. It remains to be seen if the innovative design of the Magma drone will find a place in successful drone designs for the future. As of now, the Magma is nothing more than an innovative design.

Notes

[1] 'BAE Systems tests drone controlled by blasts of air that could lead to faster and stealthier aircraft', at http://www.telegraph.co.uk/business/2017/12/13/bae-systems-tests-drone-controlled-blasts-air-could-lead-faster/, accessed on December 17, 2017.

[2] Tim Collins, 'Dawn of the killer drones: 'Flapless flight' technology is tested by BAE on its jet-powered Magma UAV to make it lighter, faster and harder to detect', December 13, 2017, at http://www.dailymail.co.uk/sciencetech/article-5175933/Deadly-magma-drone-concept-tests-flapless-flight-control.html, accessed on December 19, 2017.

[3] David Axe, "Did Iran just shoot down a US stealth drone?", July 20,2011, at https://www.wired.com/2011/07/did-iran-just-shoot-down-a-u-s-stealth-drone/, accessed on December 22, 2017

[4] Oriana Pawlyk, "US MQ-9 Reaper Drone Shot Down in Yemen: CentCom", October 02,2017, at https://www.military.com/defensetech/2017/10/02/mq-9-reaper-drone-shot-yemen-centcom, accessed on December 21, 2017.