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AI TO THE RESCUE: SWARMS AS SEAD WEAPONS IN THE FUTURE?

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With the proliferation of Air Defence weapons, viz. Surface-to-air missiles (SAM) with increasing lethality (the S-400 SAM system can intercept aircraft 400 km away), and radar-controlled Anti-aircraft guns, the odds are stacked heavily against fighter aircraft penetrating hostile airspace during conflict situations. Air Defence fighter interceptor aircraft are guided by radar to intercept ingressing aircraft. All these elements– the SAMs, the Air Defence radar and the fighter interceptor aircraft – are tied together by a robust command and control system to form a 'Layered Air Defence' concept that has been adopted by most militaries today to secure their nation's airspace. Therefore, in order to ensure that their strike aircraft do not suffer unacceptable attrition while ingressing into enemy airspace that is protected by such a robust Air Defence system, it becomes incumbent on air commanders the world over to devote effort to neutralise – or 'suppress' – enemy air defence systems in the opening rounds of a conflict.

In 1991, Saddam Hussein's military possessed one of the world's most lethal air defence capabilities in the form of the Iraqi Integrated Air Defence System (IADS), fashioned on the Soviet Air Defence system. The 'Layered Air Defence' capability hinged on long-range fighter interceptors – guided by GCI (Ground Control Interception) radar – and long/medium-range SAMs of the SA-2, SA-3 and SA-6 class for Area Defence at high, medium and low altitudes respectively. The SA-8, SA-9, SA-13 and Roland SAMs, along with the lethal ZSU-23-4P radar controlled anti-aircraft artillery (AAA) guns (with a rate of fire of upto 3400 rounds per minute) were meant for point defence. The coalition aircraft attacking targets at low levels would face a virtual 'wall' of lead formed by the 23 mm shells fired by the ZSU-23-4P, also called the 'Shilka'. All these elements of Air Defence weapons – along with their Early Warning and Fire Control Radar – were tied together through a robust computerised command and control system (the French KARI system).

Faced with such a situation, it was necessary for General Chuck Horner of the USAF, in his capacity as the Joint Force Air Component Commander (JFACC), to ensure that the lethal air defences in Iraq are neutralised before committing coalition strike aircraft to prosecute the air war. In the ensuing air war – famously known as Op DESERT STORM – the coalition air forces carried out 'Hard Kill' of radar using the High Speed Anti-Radiation missile (HARM) that locked on to the electronic transmissions by the radar and homed on to them to destroy the radar. 'Soft Kill' (i.e. 'jamming' the enemy's ground radar for the duration that friendly aircraft are within the pick-up zone of the radar – this activity is termed 'Electronic Counter Measure') by dedicated Electronic Warfare aircraft was also carried out to protect strike aircraft from being detected by enemy radar. The strike aircraft could thus carry out their mission unscathed by ground defences, as long as they stayed beyond the lethal range of the AAA guns (above 10,000 ftagl). Once the Iraqi IADS was thus neutralised and air superiority over Baghdad as well as over the Kuwaiti Theatre of Operations established, coalition aircraft were able to systematically decimate the feared Iraqi Republican Guard and other units of the Iraqi Army during the air campaign that lasted 43 days, paving the way for an easy victory by the coalition Army. Victory during the ground campaign was achieved by the coalition forces in barely 100 hours.

However, this victory came at a very high cost. A total of approx. 40,000 air-to-ground strike sorties were flown by coalition aircraft. In addition, more than 50,000 support sorties were flown during the campaign. Approximately 1600 combat aircraft were employed for prosecuting the air campaign. The total military cost of the Gulf War 1990-1991 – towards fuel, armament, aircraft losses, etc. – has been estimated at more than $ 60 billion in a report by the US Congressional Research Service released in 2010.

Fast forward to 2016

With shrinking budgets and large scale drawdown of militaries being the order of the day among most nations, spending such huge sums of monies on a short, swift campaign is likely to be an exception rather than the norm. In recent years, therefore, both the US as well as China have been experimenting with low cost micro drones (less than $ 150 per drone by some estimates – the costs would come down further with 3-D printing of these drones) that have demonstrated advanced swarm behaviour such as 'collective decision-making, adaptive formation flying, and self-healing'. What this really means is that each drone recognises another drone in its vicinity and adapts dynamically to the other's presence (just as a bird or a bee or a locust would as part of a swarm) and ensures that the pre-briefed tasks are performed as part of a team. Every member of the swarm interacts with the drone closest to it and is thus not dependent on a leader for its actions. In the test carried out by the USAF in Oct 2016, 103 mini drones were launched from three fighter aircraft, after which they quickly gathered and carried out the assigned tasks as a 'swarm'. These 'tests' were based on general instructions which the swarm decides how best to carry out in a dynamic ever-changing situation as would obtain on the battlefield. In the test video released in Jan 2017 the drones can be seen carrying out persistent recce (as a swarm) of a linear object which subsequently shifted its position – with the swarm following – till finally the swarm carried out a frenzied circling of a pin-point object (target?)[1]. These individual drones can carry small quantities of explosive which can either be dropped on the target (in which case the drone is recovered for subsequent use), or the drones could carry out a suicidal attack on the target along with the explosive.

Not to be left behind, the Chinese carried out a test with 119 micro drones on 11 Jun 2017 and by Dec 2017, at the Global Fortune Forum in Guangzhou, had bettered that to 1180 micro drones flying in close proximity of each other and carrying out coordinated tasks.

The ability to fly in close proximity with each other and perform tasks that have been programmed as general tasks, i.e. 'carry out recce of a defined area', 'carry out destruction of a mobile missile launcher/radar', etc., has become possible with the advances in computing power, permitting a modicum of Artificial Intelligence being fed into these micro drones. This has given the military planner the flexibility to plan their use for overwhelming and confusing integrated air defence systems (like the Iraqi IADS discussed above), thereby creating conditions that would permit own strike aircraft to continue with their missions undetected and safe from terminal defences.

This ability of a swarm to carry out a military mission appears to have already been put into practice, as gleaned from reports emanating from Syria. On the night of 5-6 Jan 2018, ten micro drones were observed by radar heading towards Russia's Khmeimim air base in Latakia governorate (near Syria's Tartus Naval Base), while three were seen heading towards the Tartus naval base on the Mediterranean Sea. Russian Air Defence missiles shot down seven drones while the electronic warfare systems employed by the Russians forced three to land nearby. The drones were examined and found to carry ten bomblets each, with an explosive charge of one pound in each of the bomblets. There had been an attack on the airbase on New Year's Eve as well, which was passed off by the Russians as an attack by insurgents using mortars. In this attack (on New Year's Eve) seven aircraft had been damaged and two Russian soldiers had been killed. Maybe the drones did carry out a successful attack after all![2]

So far it was assumed that the airbase is a safe sanctuary for fighter aircraft. In the dawning age of 'swarms', is this about to change?

(Disclaimer: The views and opinions expressed in this article are those of the author and do not necessarily reflect the position of the Centre for Air Power Studies [CAPS])

Keywords: Air Defence, Artificial Intelligence, SWARMs, UAVs

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[1] F/A-18 Super Hornets Launch 103 Perdix Drone Swarm; Available at https://www.youtube.com/watch?v=OixSNQp0S_k, Accessed on January 30, 2018.

[2] "Russia Says January 5th Attack On Its Syrian Air Base Was By A Swarm Of Drones"; by Tyler Rogoway; *The Warzone*; January 8, 2018; http://www.thedrive.com/the-war-zone/17493/russia-says-january-5th-attack-on-its-syrian-air-base-was-by-a-swarm-of-drones, Accessed on January 30, 2018.