Strategy of Air Supremacy and Defense for a Quick End to Twenty-First Century Conflict – Research Required

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Abstract: Air supremacy including land supremacy depends on equipment and weapons researched and developed with superior engineering knowledge, design and practice. There is the analytical and computational part, as well as the essential product realization portion. Superiority in engineering knowledge and practice is requisite. There are also tell-tale clues from the lyrics of national anthems, which may speak of a nation's desire for military superiority, or at least of being undaunted by military conflict to maintain a nation's independence. Airborne drones are being recognized as being essential for air supremacy in the twenty-first century, and are the focus of this article. The technology of airborne drones rests on the shoulders of aircraft technology, on robotics and computer technology, especially at the micro-scale end of fast and powerful computers. This work is focused on the research and development required to maintain/ acquire air supremacy in this twenty-first century, so that military conflicts need not drag on. Numerous lives can be spared as a consequence.

Keywords: Drones, air war, military dominance, development.

INTRODUCTION

Air supremacy is a status during a conflict where one nation or party has absolute control of air power and air warfare over their opponents. It is defined by the United States Department of Defense as well as the North Atlantic Treaty Organization (NATO) as the "degree of air superiority wherein the opposing air force is incapable of effective interference," [1,2]. In as much as the above definition implies aircrafts of the latest kind, it should be emphasized that in this modern age, the definition has to include unmanned vehicles or drones. An airborne drone is an unmanned aircraft that navigates without human intervention. The current article gives special focus on airborne drones and associated technologies.

Western Europe colonized the world, and Eastern Europe (Russia) colonized the countries neighboring her in Europe and Asia. The colonization of the world was facilitated by supremacy of the seas and land. World War I was precipitated in part by the rivalry between the European powers. World War I was won by the ultimate supremacy of the air and the land. Air supremacy changed hands throughout the war [3]. World War II was won by the side with the atomic bomb that was conveyed by airplanes. Supremacy of the air is necessary to win a war in the twenty-first century. One of the best recent examples would be the killing of the leader and founder of al-Qaeda in his place of hiding with the help of drones. Intelligence and secrecy are essential for success of any campaign or planned acts of aggression. Airborne Unmanned Autonomous Vehicles (UAVs) or airborne drones are particularly suitable for tasks that require secrecy or difficulty of detention, coupled with being very suitable to convey electronic gadgetry which can capture information *via* sights and sounds.

LITERATURE SURVEY

There is an explanation in Wikipedia about air supremacy [3]. In 1921, Giulio Douhet, a war theorist, published *The Command of the Air* [4], where he predicted that air dominance was essential for victory in human conflict that were to come. He was no doubt inspired by Italy's air dominance over the Austro-Hungarian empire's air troops during World War I. The decisive battle was the Battle of Vittorio Veneto, Oct. 1918 [3].

Swarming of UAVs is a well-known popular field of study. The Wyss Institute's (at Harvard University) engineers have succeeded in making an inexpensive robot they named "Kilobot" [5]. The mass-produced Kilobot has innovative locomotion employing vibration motors, and uses reflected infrared light for communicating with one another. The investigators wrote an algorithm for programmable self-assembly in aggregation that gave the robots the ability to acquire a predetermined form without feedback and control from people. They managed to create a swarm out of 1,024 small robots in order to study collective behaviors.

Airborne drones may be powered by high-performance miniature power sources. Pikul *et al*. [6] reported "lithium ion microbatteries with power

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densities up to 7.4 $mW.cm^{-2}$ mm^{-1}, which matches or exceeds that of the top supercapacitors, and which is 2,000 times higher than that of other microbatteries. Their most important contribution is that the battery microarchitecture can simultaneously optimize ion and electron transport for high-power delivery." They produced a "three-dimensional bicontinuous interdigitated microelectrodes" [6].

Low altitude penetration fighter plane research work include [7,8]. These research articles have much to do with modeling and optimization. Practical successes in this aspect of the topic under discussion would scarcely be found in the published literature. One should expect this situation since the subject has to deal with clandestine operations and homeland security.

Flapping flight research includes references [9-13]. In [9], the researchers employed an engineered insect model to collect data regarding the rotational forces involved in a flapping insect wing. The model insect was dynamically sized. In [10], the researchers determined that bats, insects and birds cruised at an optimum range of the Strouhal number (St), which is $0.2 < St < 0.4$. This fell in line with the range found by earlier researchers for bony fish, dolphins and sharks. Birch and Dickinson [11] studied the interactions between the wing and the wake during a flight where the wings flapped. Deng *et al*. [12] focused on the design of flight control of robotic insects. These insects were engineered to mimic real biological ones. Hovering flight is an interesting and relevant branch of animal flight. Cheng *et al*. [13] published in 2014 the three-dimensional structure of the wake of such a flight with flapping wings.

The vulnerability of space satellites has been written up in [14]. Apparently, the amateur community has identified U.S. classified satellites. In [14], the author goes on to state that "Orbital predictions are accurate enough that a country or other entity wishing to organize a concealment and deception effort against satellite reconnaissance could do so." An unmanned U.S. Air Force space aircraft shrouded in secrecy hit the news in 2010 [15].

Flying drones for military purposes would typically not fall into the category of civilian aviation, but research in this civilian field of Unmanned Aircraft Systems (UASs) could be relevant. Unmanned Aircraft Systems are not much in use for civil aviation at this time. However, as hazards increase with more and more drones flying around, the chances of accidents, etc. increase. In [16], regulations with regards UASs are discussed. Reference [17] is also a publication in this area.

RESEARCH AREAS

One of the most advanced technologies being researched is to attack with an autonomous swarm of airborne drones. In the first instance, it would seem like the ultimate aim is to build robotic drones which have mastered the science and art of swarming, because it would be difficult to fend off a flying drone that had attack capabilities, let alone a swarm of them. If the flying drones are large enough, the swarm will be easier to detect than the single drone and the stealth factor will be lost. If the airborne robots are small enough like insects, then methods used to destroy a swarm of insects could be emulated. The response could be with a metallic shield or net of some kind to capture and destroy these swarms, as one would destroy a swarm of insects. Another technology is a bigger and more powerful drone that can 'zap' them out from the sky, several or many at a time. A squad of four or more superior drones could accomplish the task, if fitted with the right gear. Depending on the level of the detection capabilities of these swarming drones, the defensive side could even use existing land-based artillery to accomplish the job. It is even conceivable that a rifle with buck shots could be effective defensively against a swarm of flying drones of the right size and capabilities.

For discussion purposes, let us assume that the ultimate in biomimetic insects has been achieved; a swarm of 'hornets' have been manufactured and programmed to be offensive. To arm such small robots, one has to resort to things like poison, by carrying the mimicry a step further. One of the points of the current article is that the same destructive objective may be accomplished *via* chemical warfare with older technology, in a less risky method of deployment. A lot of resources would then have been wasted if no other use can be found for the findings and products of the funded research and development.

Space satellites can be used to help gather visual information and locate targets. This can be good for offense or defense. Surveillance cameras in space that cannot be easily knocked off from the sky, is definitely one response to defensive weapons that can knock off the drones themselves because the drones fly at a lower level. Research area in this technology could push towards more detail and more capabilities to

zoom into details of a target area by these low earth orbit spy satellites.

With greater resolution and detail in mind, research has been done and is being carried out regarding synthetic aperture radar (SAR). In [18], the researchers described the processing of SAR data with an innovative method. The MIT researchers in [19] used an innovative method for image reconstruction. One of the ways of deployment of SAR technology would be to use swarming drones. In the idealized situation, the stealth factor would be reasonably increased since few would expect such an inconspicuous method of conveying a radar. For ideal conditions, the swarm of drones has to be in perfect formation, even in the presence of air currents, turbulence and random vortices. One can see marvelously complex situations of fluid mechanical problems. The avionics side would also be challenging, even if the drones themselves are carrying transponders on board.

Research could be done on drone-on-drone fighting, as in dog-fights by fighter pilots. A draw or a non-convincing win on this front might not necessary result in a quick end to the conflict. Even with a convincing win, it is difficult to see why the losing side would concede, ending the conflict. Ground troops are necessary or land supremacy needs to be established. The complexity of the required research would rank it high in importance to develop the technology in this direction. However, the end result of not being capable to be the main cause for ending a military conflict, would lower its priority. One could argue that the Battle of Britain in 1940, an air campaign, was a turning point of World War II on the European western front. It is agreed that it might have been a crucial turning point, but it is commonly accepted that it was the side with the atomic bomb which won the war.

Commercial cameras are readily available made to 5 mm. lens size at this time. The technology is moving to ever smaller lenses, with pinhole lens technology. It may be sooner rather than later, that cameras will be ready for smaller UAVs, the size of insects. Cameras disguised as flying insect eyes seem like an obvious camouflage. It follows that computers that are the size of insect heads would aid in the camouflage.

Video cameras should be able to spot something which is out of the ordinary, without human aid. This would require large databases of views of the target environment. Accomplishment of this objective can be achieved *via* small processors with great capabilities to be carried on the drone itself, or in real time *via* transmission. For real time analysis *via* wireless signals, these processes need to take place without being detected and intercepted. The appropriate encryption technology needs to be in place as one course of action for research. On the other hand, detection of any kind of wirelessly transmitted digital information, even though encrypted, may be sufficient to initiate defensive activities to knock the invading forces out of the sky.

UAVs can be reduced to the size of insects, e.g. bees. There is a need for an energy source to power and control these UAVs. Transmitting energy wirelessly to these UAVs is being researched as a possible alternative to batteries. Dr. N. Tesla showed the concept over a century ago. A review of TESLA technology [20] research and sister technologies was provided by Mandal [21]. Transmitting large amounts of electric power wirelessly for household consumption is a field of ongoing research [22,23].

A great deal of research and development needs to be done in the field of battery technology. For ordinary civilian transportation, batteries need to have high energy as well as high power, and yet be of a size suitable for the vehicle it powers. Batteries for flying drones need to be designed to be smaller still, and yet maintain high power and high energy. The level of power and energy determines and limits the kind of tasks which the UAVs can be capable of carrying out in their mission. The work of the researchers at the University of Illinois and by other successful researchers, need to be developed into commercial products [6].

DISCUSSION AND CONCLUSION

One could argue that the mind controls the physical actions of the human body, and that the common goal of the minds of a nation would be expressed in a nation's anthem. Hence, it is a proposition here that an indicator of the ambitions of the said nation to be a world military power can be found in its national anthem. If the minds and aspirations of a nation are encapsulated in its national anthem, one would find proof in the lyrics of national anthems. With this in mind, Table **1** was constructed. It is interesting to note that 'victory' and reference to human conflict or struggle, etc. are mentioned or implied in some countries, and not in many others.

The national anthems of the five permanent members of the United Nations (UN) Security Council,

Table 1: Countries and their Anthem Characteristics

Country	Anthem with reference to victory and/or conflict
Iran	Yes (with 'martyrs' of the religion)
North Korea	Yes (with 'will of the people' and 'soaring strength')
Turkey	Yes (with 'martyrs' of the religion) – holdover from Ottoman Empire
Myanmar	Yes
Bangladesh	No
Pakistan	No
India	No (with 'victory of the mind')
Indonesia	No
Malaysia	No
Singapore	No
Saudi Arabia	No
South Korea	No
Japan	No
Germany	No
Denmark	Yes
China	Yes
Russia	Yes (with 'mighty will' and 'strength')
France	Yes
United Kingdom	Yes
United States	Yes

all refer to victory and/or human conflict. These are the United States, the United Kingdom, Russia, China and France. The first two are the current and the previous superpower in the world (U.K.'s era was before World War I). The noticeably non-permanent members of the UN Security Council who have these revealing words in their anthems are Myanmar, Turkey, Iran, North Korea and Denmark, of the countries investigated. The other countries listed do not state in their national anthems any militant aspirations or reference to victory or conflict.

Even though it seems that a necessary condition for military success is for a national anthem that focuses people's attention to military prowess (at least as one of the many goals), it is insufficient for military excellence. That is only the first step but an important one, since the young citizens of the nation are taught to repeat the lyrics at an impressionable age that helps in building patriotism, etc. Real physical arsenal, aircraft power and manpower are required for air supremacy, lending to the superior side the option to choose an expedient conclusion to military conflict. The research and development required for air supremacy is the topic under focus in the present article. Another interesting fact which surfaced when studying lyrics of national anthem is the existence of many anthems with reference to human conflict and/or fighting. This fact implies that 'conflict' is one human phenomenon which will not go away anytime soon.

Air supremacy including land supremacy depends on equipment and weapons researched and developed with superior engineering knowledge, design and practice. Many of them need energy – mechanical, electrical, chemical. The technology of drones is also heavily dependent on computer technology, especially at the very small end of very speedy and powerful computers. This article is a discussion about the research and development required to retain/ acquire air supremacy in this twenty-first century, so that military conflicts can be settled quickly and countless human lives saved because of the shortness of time involved.

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