Bulletin of "Carol I" National Defence University
10.12753/2284-9378-19-03

THE USE OF RADARS ONBOARD THE AEROSTATS IN AIR SURVEILLANCE MISSIONS

Colonel Instructor 1st degree Pătru PÎRJOL*

The military conflicts of the last century revealed the importance of information in the conduct of air force missions regarding the neutralization of objectives that were important for the enemy's war effort. The need to ensure information support for the decision-making processes resulted in the design of air surveillance systems, capable of providing the information required by the structures that specialized in countering of the air force threats. The quality of information provided was influenced by the passive or active air surveillance sensors, due to their superior power of detection over long distances and low altitudes.

Keywords: air surveillance; radar; sensors; threats; air surveillance systems.

The beginning of the 21st century confirmed the fact that the stable security environment is the result of cooperation within the international community through the promotion of institutional dialogue and through the important role played by the international organizations in defining and maintaining it. Therefore, an ongoing process started being conducted within the international community to the purpose of identifying and implementing solutions to maintain the climate of peace and stability necessary to build and preserve the security architecture of the new global society.

A consequence of this transformation was the new risks and threats to security that resulted in new hotbed of crises and tensions that represented the seeds of new types of asymmetric threats. Adapting military actions to the new threats and challenges involves the identification and implementation of alternate ways to use military structures to counteract them in an efficient way. In this respect, we can state that information can be a common thread in reducing the impact of risks and threats to the security environment, which amplifies the actions taken against state or non-state actors. Obtaining, analyzing and using information in a proper way will result in building the real-time image of the area of interest and will assist in identifying current and future risks, threats and dangers by ensuring the support for the necessary actions meant to counteract and diminish them.

The lack of information about the enemy and enemy's intentions will generate uncertainty to such a degree that it will have an impact on the complexity of the environment where crises and conflicts arise. The history of military art has demonstrated, a situation also conformed without any doubt by later conflicts, that "war is the realm of uncertainty; three quarters of the factors on which action is based are enveloped in a fog of greater or lesser uncertainty."[1] The uncertainty of the modern battlefield and of the confrontational environment will increase the potential of state or non-state actors to conduct asymmetric actions. This increased ability of using asymmetric actions by the actors involved in crisis or conflict will be influenced in a direct proportion by the uncertainty from the area where conflict or crisis appears and evolves, resulting in an increased effect of surprise at strategic, operative and tactical level.

By reducing the level of uncertainty, we can state that the risks will be diminished in areas where asymmetric threats can appear due to the actors present there. This end can be met thorough information superiority on a potential enemy by knowing the real-time situation and by determining possible evolutions of crisis and conflict based on the analysis of information in-hand. Information superiority on the enemy is "a state on imbalance in one's favor (relative advantage) in the information domain that is achieved by being able to get the right information to the right people at the right time in the right form by denying an adversary the ability to do the same." [2]

*** "Carol I" National Defence University***
e-mail: *petpirjol@gmail.com*

The control of information from the area of interest will take into account not only the protection of the organic sources of information, but also the denial of enemy's access to important information and specific technologies used to process it. The result will reside in influencing the decision-making processes, and, at the same time, the way in which actions are planned and conducted. The information in-hand will allow organic forces to maintain control over the battlefield and retain their high potential to influence and modify in the desired way the decisions made by the enemy at all levels of military command.

The basis of information superiority is represented by sensors, which collect and transmit the data necessary for drafting the image of the area of interest, ensuring the identification of threats and obtaining the sound reaction, so that the impact on organic forces and actions will be diminished. In this respect, networks of sensors have been scattered over a larger area in order to obtain the permanent surveillance of the areas of interest and the early identification of instability elements or the outburst of threats to the security environment. The information support ensured by this type of sensors will contribute to obtaining the flux of information about the situation of own forces and of those of the enemy's. In addition, other information will be important such as that related to the need for support, the need or allocation of resources, the mission, about the area of confrontation, the hydro-meteorological situation corresponding to the combat area, the evaluation of actions performed by own forces as well as about the way in which the combat environment will evolve[3].

Conflicts undertaken in the latest decades have stressed the importance of the air force in conducting military operations. They thus demonstrated that mission success and reaching the established objectives are based on the synergetic action of all military structures by using a large variety of weapons systems, placed on aerial platforms that had a great impact on the battlefield and on the military actions, conducted by organic forces. These conflicts have confirmed the importance of networks of sensors in surveilling the area of operations, stressing the need to provide the networks with more complex systems capable of ensuring the rapid identification of enemy's objectives and the strikes necessary to neutralize or destroy them. In the case of the armed forces, it is important that an air surveillance system be organized and developed to include sensors meant for air surveillance. This system is capable of ensuring permanent air surveillance and early warning regarding the threats to the air medium in order to defend the area of operations and the suzerainty of a state in its airspace. The importance of this system stems from its use not only as provider of information about current threats in the airspace, but also from its contribution to the information processes in the air force in order to achieve airspace control. In our opinion, the air surveillance system is a crucial factor in achieving the air power of a state as it contributes through the information provided to reaching and maintaining a proper level of national security.

The recent advancement in science and technology has brought about air surveillance systems that are extremely complex due to the more qualitative and quantitative sensor networks capable of conducting air surveillance and reconnaissance missions, according to the requirements of the modern battlefield. The improvement of air surveillance systems is closely related to the evolution in air means technology; this qualitative leapfrog will lead in a short period to the necessity to identify and develop sensor networks meant to detect the new air means and ensure at the same time the neutralization of their technological advantage. These systems of sensors use passive and active principles and methods for detection, their detection power being dependent upon their technical and tactical characteristics, upon their capacity to focus on objectives according to the situation from the surveilled area, upon the transmission speed of data and information, and in addition, upon the independent technological elements such as the characteristics of the terrain and the type of platform which holds the sensors.

Having a complex image of the area of interest involves placing the sensors at a higher ground in order to detect the elements of the landscape as well as the means present in the air, on land and on sea. Systems of sensors are placed at a higher altitude with the help of air and space platforms such as satellites, aircraft, helicopters, unmanned air means and, in some cases, aerostats. These platforms also play the role of movement vectors and place these sensors above or near the area of interest in

order to obtain the best position for the collection, processing and shaping of the operational image of the area. Next, we will analyze their impact on the security level of states, which use them both for military actions, as well as on missions, for the protection of frontiers and counteraction of cross-border crime.

Helium aerostats are air platforms for surveillance systems of sensors, which due to their reduced costs are a viable alternative to other types of air platforms. These aerostats are anchored to the ground using a tethered cable that ensures altitudes of at least 3,000 meters, being capable to support systems of sensors, for military and civilian missions. The helium aerostat is made of the following components: helium-base floating platform, mooring platform with sensors, attached to the aerostat, remote control system of the sensors, communication equipment for the transmission of data, power generator and tethered system with cable.

A system designed for the advanced warning and control of airspace is the Joint Land Attack Cruise Missile Defence Elevated Netted Sensor System (JLENS), which detects manned or unmanned aircraft, ground vehicles and light maritime vessels (boats) as well as other threats to the security of a state.

JLENS has two aerostats, which are used at an altitude of at least 3000 meters, being able to stay afloat for up to 30 days. Each aerostat has a radar system for different missions respectively one for surveillance and one with X band for fire control, meant to provide precise information regarding the strikes on detected threats. Beside the two radar systems, JLENS benefits from communication equipment for data transmission, tethered cables, tethered systems and powering stations.

The main parameters of JLENS[4] are the following:"Number of aerostats: 2

- destination: air surveillance;
- length: 74 m;
- length of tethered cable: 3,000 m;
- payload capacity: 3,175 kg;
- Radar range: 550 km."[5]

The data provided by JLENS are processed and used to complete a wide variety of military and civilian missions among which we could mention border surveillance, migration routes, drug trafficking routes, ammunitions, etc. JLENS can be integrated with defence systems which are used by U.S. Army, Navy and Air Force, such as the one for the defense against Patriot PAC -3, Standard Missile 3 (SM-3), engaged by Aegis BMD, as well as other defensive and command and control means, which provide support for the defence against fixed or rotary-wing aircraft, cruise missiles, unmanned aircraft, ballistic missiles, ground moving targets, etc.

The possibility to place on the platform multispectral, passive, electro-optic and infrared detection sensors will improve the detection ability under difficult conditions (smoke, fog, etc.) making the surveillance radar highly integrated with this system of sensors.

Currently, due to budgetary shortcomings the JLENS program has come to a halt.

Another air surveillance system that uses the aerostat as a platform, used by the USA, is the Tethered Aerostat Radar System (TARS), built by Lockheed Martin. The radar system used on this platform can discover, track and identify the air targets up to 400 km, including aircraft that fly on low altitudes.

The main parameters of TARS[6] are the following:

- Purpose: air surveillance;
- Volume: 275,000 and 420,000 cubic feet (12,000 m^3);
- *diameter*: 19 m (275K), 21 m (420K);
- *length*: 56.6 m (275K), 63.55 (420K);
- *tether length*: 25,000 feet (7.600 m);
- *payload*: 550 kg (275K), 1,000 Kg (420K);
- *maximum detection range*: 200 nautical miles (400 km).

The USA used TARS for civilian and military missions. TARS is used on civilian missions for the surveillance of the border with Mexico and of the adjacent maritime area of the Florida Peninsula with the purpose of preventing drug trafficking in the area. The military missions consist of transiting to NORAD the data from the surveillance radar mounted on this platform and using them to sketch up the recognized air picture and ensuring air supremacy.

The USA uses the following operational sites of the TARS system: Yuma and Fort Huachuca in Arizona; Deming in New Mexico; Marfa, Eagle Pass and Rio Grande City in Texas; Cudjoe Key in Florida; Lajas in Puerto Rico; Morgan City in

Louisiana and Matagorda in Texas[7].

TARS is the only permanent airspace and maritime surveillance system designed especially for performing border security missions and is superior to the other surveillance systems placed on airplanes, helicopters and unmanned systems. The use of these platforms to place the air surveillance, radars and sensors at an altitude increases their detection capacity and assists in discovering the light aircraft used in drug trafficking on the border area. Moreover, the physical visibility of the aerostat is a deterring factor to illegal activities performed in the air, at sea and on land due to the increased detection capacity of sensors and of the great reaction capacity of authorities for countering and neutralizing the detected threats.

Another class of aerostats, mainly used by the military, is the tactical one. Tactical aerostats are used by the Armed Forces in surveillance missions being constructively similar to TARS. Tactical aerostats include three models that are used for detecting threats from the area of interest, for the permanent surveillance of ground forces and means, early detection of threats to military objectives and forces, being considered complementary surveillance systems with unmanned air systems. The smallest model can be placed rapidly in the area of interest due to the portable tethered systems being, used for air surveillance of small areas. These aerostats are elevated at an altitudes varying between 150 and 1,500 meters having onboard radars, infrared and electro-optic cameras as well as communication equipment for the data collected or for retransmission of signals from inaccessible areas.

The transfer from the USA Army of this technology to structures that guard the frontiers is the first step in the civilian use of this category of aerostats. Tactical aerostats will be information sources meant to supplement the information obtained by TARS and, with the assistance of electro-optic and infrared sensors, they will provide precise, real-time information to the structures, involved in border protection.

Sensor systems placed on aerostats combine the advantages offered by air platforms (greater range, no limitations imposed by the terrain, possibility of aircraft detection at low altitudes) with the advantages provided by these platforms among which the low costs, representing 15-20% of the cost of using fixed aircraft and the ability to keep the area of interest under surveillance, day and night, including under difficult weather conditions. The disadvantages of using these platforms are the fixed location and their vulnerability when it comes to severe weather conditions.

The data obtained by the sensors, placed on aerostats, are extremely valuable due to their excellent quality, thus contributing to sketching a clear picture of the area of interest, ensuring the identification of threats and the information used to neutralize them. In this respect, the continuous evaluation of risks and threats will determine their evolution trends and will contribute to the identification of solutions that are adapted to the particular situation from the area of interest, which will lead to the neutralization of the effects they generate.

From military perspective, the sensors placed on platforms will contribute to obtaining the real image of the area of interest and will ensure the information support for the decision-making process at structures with special missions, which will contribute to increased efficiency of organic forces.

In conclusion, sensor systems placed on aerostats, through their capacity to permanently observe the area of interest, can detect a large range of aircraft that fly at low altitudes thus ensuring the improvement of parameters in the surveilled areas and providing early warning. The information provided will contribute to creating a complete and real air picture of the surveilled area in order to ensure the information support for conducting a variety of military and civilian missions. The reduced costs, their permanent availability and the advantages offered by altitude surveillance recommend sensors mounted on aerostats as a competitive system that, together with the other sensor systems, will contribute to the identification and neutralization of threats, thus ensuring increased state security.

NOTES:

1 Carl von Clausewitz, *Despre război,* Editura Militară, Bucureşti, 1982, p.84.

2 David S. Alberts, John Gartska, Richard Hayes, David Signori, *Understanding Information Age Warfare*, CCR Publications, August 2001.

3 E. Bădălan, coordonator, *Concepte strategice şi*

operative de actualitate, Editura Centrul-Tehnic Editorial al Armatei, Bucureşti, 2004, pp. 68-82.

4 https://www.globalsecurity.org/space/systems/jlens.htm, accessed on 13.08.2019 at 18.00.

5 http://raytheon.mediaroom.com/index.php?s=43&item=2386, accessed on 13.08.2019 at 18.00.

6 https://www.cbp.gov/document/fact-sheets/tethered-aerostat-radar-system, accessed on 14.08.2019 at 18.00

7 https://www.harris.com/sites/default/files/downloads/solutions/tethered-aerostat-radar-systems-tars-data-sheet_0.pdf, accessed on 28.08.2019 at 21.00.

BIBLIOGRAPHY

*** *Strategia Naţională de Apărare a Ţării* pentru perioada 2015 - 2019, Bucureşti, 2015.

Bădălan E., coordonator, *Concepte strategice şi operative de actualitate*, Editura Centrul-Tehnic Editorial al Armatei, Bucureşti, 2004.

Clausewitz Carl von, *Despre război,* Editura Militară, Bucureşti, 1982.

Alberts David S., Gartska John, Hayes Richard, Signori David, *Understanding Information Age Warfare*, CCR Publications, august 2001.

https://www.harris.com/sites/default/files/downloads/solutions/tethered-aerostat-radar-systems-tars-data-sheet_0.pdf

http://raytheon.mediaroom.com/index.php?s=43&item=2386

https://www.cbp.gov/document/fact-sheets/tethered-aerostat-radar-system

https://www.globalsecurity.org/space/systems/jlens.htm\