



SECURITY OF THE AIRSPACE OF THE LAND FORCES FROM THE PERSPECTIVE OF THE AIR DEFENCE RESPONSE SYSTEMS

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Abstract: Contextually approached, the concept of security is one of the essential conditions of existence and expression of the will on self-determination of any entity to which we can refer. From a military point of view, the security of forces and their actions has often been assimilated with the multitude of safeguard measures against the potential danger in a particular action environment on land, air, sea or water, generally expressed as multidimensional protection. The level of unprecedented technology applied to the confrontation environments, has prompted natural reactions to identify the best air and air defence response solutions for the security of the air space. Following the personal scientific research approach, we consider particularly important to follow the ratio of danger distribution of the air threat in the air defence system countermeasure, especially within the land forces, by highlighting the "fight with the seconds" implicitly generated by "the vector of speed of action" of the hostile aircraft in the airspace of responsibility.

Keywords: security; air defence response; "plug-and-fight"; collaborative network.

The multidimensionality of the modern battle space has naturally determined a corresponding involvement of the degree of technology of the forces and of the military engagement means for maintaining or gaining the security status vital to any structure or entity to which we can relate. Due to the catastrophic events occurred in the airspace (September 11, 2001, USA, or 17.07.2014 Ukraine, etc.) the need for air security went beyond the conceptual environment of exclusive application to the military domain, so that more often concerns were raised related to the cross-border illicit air actions identified as new threats to the states and international communities.

Issues concerning air space security have become a priority in the air defense sector because of the terrorist threats made by hijacking civilian aircraft but also by the widespread use of small radio guided aircraft designed and equipped for performing multi-task missions. The effort of specialists in the field of military and civilian assets security consists in defining and understanding the mutations occurring in the means and forms of organization adopted by various military, paramilitary or terrorist structures. The technological gap and the limited access of certain hostile parts involved

in direct or terrorist conflict to the latest technical and scientific innovations can be estimated only as a matter of time and not as a permanent advantage of the most updated modern military combat systems. The arming race generated by the Cold War between the consecrated political and military opponents, was the starting point of what we know today as a split of the major conflict in "hot sports of local military conflict" that because of management mistakes might extend much beyond the initially determined expectations.

It is further expected to witness a radical transformation of the traditional battlefield as we know it by widely employing the computerized information platforms, the microelectronics applied in all areas of social life and their expansion to all known existential environments. In this regard, we consider that the overspecialization of the air threat countermeasure systems may be an important step for generating sequential action opportunity within the integrated air defence response process which triggers the disuse of most of the technical systems designed for individual actions characteristic to the years 1970s – 1980s. In order to exemplify, the stealth technology has determined a strong decrease of the major role of discovering aerial targets by the radiolocation structures with the traditionally known radar types. The same happened with some air defence systems where the overloads that the aircraft can carry when performing avoiding

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maneuvers have increased significantly compared to the maximum gravitational limits endured by the anti-aircraft missile body. Also, the electronic warfare measures (jamming) available to the aircraft make useless the search, track, combat and destroy subsystems specific to larger or smaller scale air defence systems.

In order to improve the technological gap between the opportunities for air action and counter air action work is presently on the way to identify new types of air defence systems, tactics and methods of use in battle aimed at discouraging and providing a credible air defense for a variety of military or civilian objectives. The tendencies to make the collaborative working effective have been directed mainly towards the management, command and control of various similar or totally different air defence artillery and missile systems. One of the results of such a joint air defence effort of the 2000s can be exemplified by the concept of "Medium Extended Air Defense System", or MEADS of the partnership between USA, Germany and Italy, extended to other countries such as Poland¹.

Although the MEADS program was initially designed as an alternative to the obsolete air

defence missile systems PATRIOT, HAWK and MIM14 NIKE-HERCULES, it has managed to become, due to the involvement of NATO the first 360° air defence multinational integrated system of the land forces and of the stationary objectives in the territory against all air threats such as tactical, ballistic, or cruise missiles, helicopters, unmanned aerial vehicles, multi-task aircraft, large caliber missiles and projectiles. The main features of the collaborative air defense architecture MEADS are mainly given by the high degree of interoperability, the extended 360° air defense space, the increased mobility and responsiveness on land and in the air. These features are fulfilled by an integrated air defence system, fully interoperable with NATO structures, designed to respond to the new issues of air threats proliferation.

As far as we are concerned, we would like to present some of our observations on the concept of integrated air defense against some of the possibilities of engaging a fight in the airspace of hostile air platforms. The first aspect is related to the mode of high-risk action against a certain size ground target where the aircraft, with or without human personnel on board, may act as in Figure no. 1.

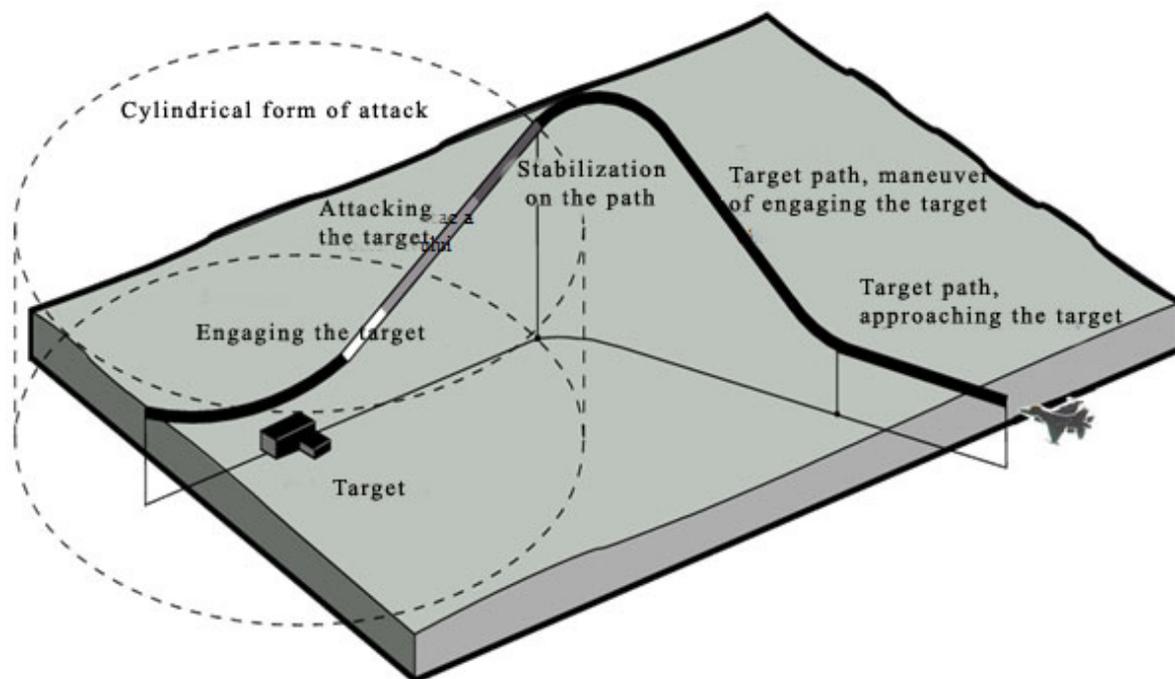


Figure no. 1 Interpretative variant of the mode of air action for deceiving the air defence system while hitting a ground target

¹<http://www.pddnet.com/news/2015/01/meads-ready-transition-european-follow-programs>

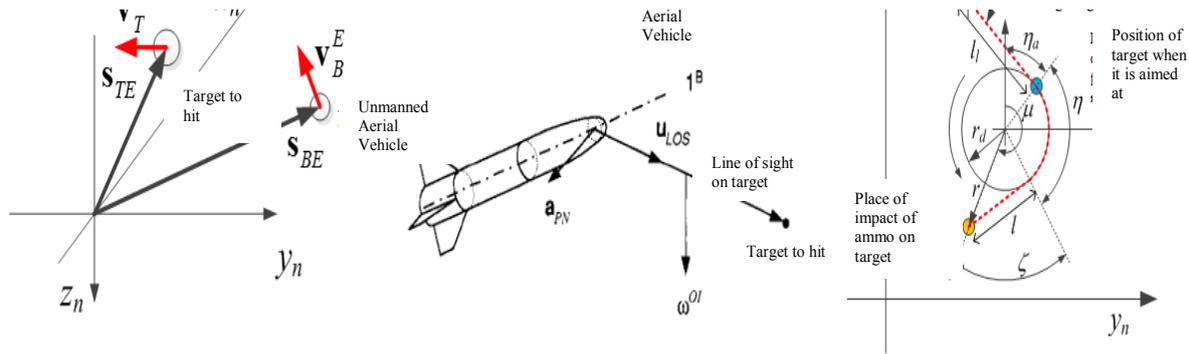


Figure no. 2 Action of the motion vectors of the aircraft after tracking the target

Interpreting the aircraft's mode of action, as in Figure 01, can be done from various points of view: the shape of the path, "the speed of approaching" the target, different capabilities (deceiving the air defence, air and ground coordination, independent decision and engagement of multiple targets, etc.), possibilities of surviving after the interaction with the defending forces, etc. Irrespective of the mode of air action, the aircraft (manned or unmanned) kinetically behaves like any other vehicle, its behavior being describable by the action of the motion vectors in relation to the target intended to be hit. For example, Figure no. 2 shows some descriptive elements highlighting the reference systems: one related to the aircraft, another one related to the targeted objective and a third system given by the air defence system.

Our observation is related to a new perspective on fighting the air enemy, based on the describable mathematics for a trajectory seen from many points of view, from several reference systems. The two trends of expressing the accomplishment of the mission are given by the aircraft reference system in relation to the intended target reference system and a second element is given by the air defence

component reference system and the reference system of the attacking air target. The two directions of action can be described as a sequence of "events" that could occur in time (expressed in seconds and tens of seconds). The identified events may refer both to the aircraft - target interaction and to the air defence system - aircraft interaction. What links the two events (on the same unit of time) is fulfilling the mission; the aircraft must destroy the intended target, and the air defence must destroy the hostile aircraft. Mathematically expressed, this can translate by positioning in space and time certain motion vectors describing the coherent positioning of the reference systems that simultaneously describe air and air defence actions. For example, for the air defence sequence of searching and tracking the aircraft with the highest degree of hostility in the situation of "linking" the aircraft's interest of annihilating the air defence system, tactically speaking, several interposing reference systems can arise by employing UAVs with the "shield effect" as shown in Figure 03. The shield effect can be one of the methods of deceiving the air defence response system, be it a newer generation one, in the sense of misleading on the real air danger, on

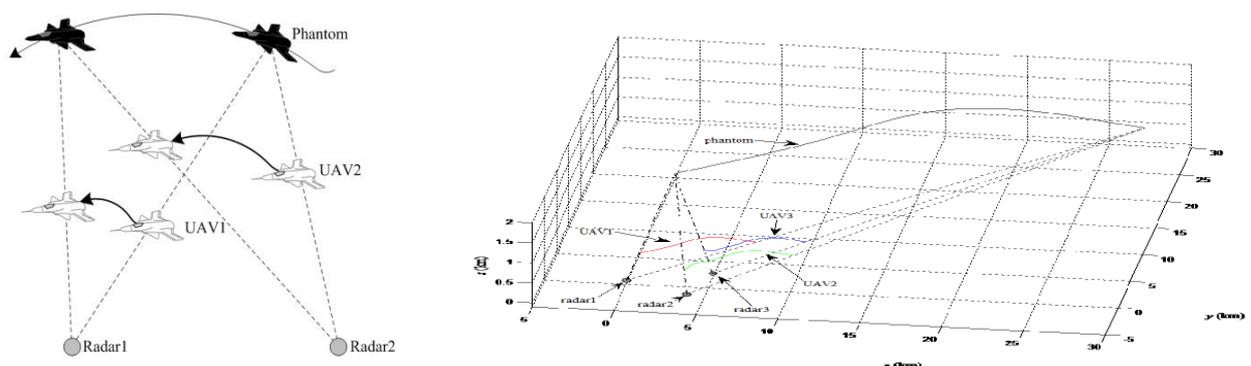


Figure no. 3 Involving UAVs in the tactics of deceiving a network of radar stations¹

¹http://ascl.kaist.ac.kr/uav_gnc_02 - accessed on 29.04.2015



engaging the most dangerous target. In order to understand the phenomena of air defence and to identify certain solutions to solve *the problem of the impact of the air defence projectile/ missile on the target* (its destruction), we opted for applying *the theory of the reference systems*. In this concept of the reference systems, new research directions arise by applying the concept of interaction in *double context, of space and time*. The issues related to space describe the position of the involved elements (aircraft, objective, air defence system) by means of position coordinates x , y and z (latitude, longitude and height). The issues related to time are given by the three moments: present, recent past and immediate future. Due to the high speeds of airspace action, we opted for explaining by applying the notion of "immediate" (seconds and tens of seconds).

Our research effort on finding a solution to a particular air defence case focused on defining and applying the concept of "the reference systems" which has the power to explain what happens in the air, on account of the interaction between the hostile aircraft and the air defence system in question. The airspace of responsibility of the land forces describes very well the typology of the path of an air target, which, seen from the perspective of the air defence action: reconnaissance, detection, identification, tracking, combat and destruction, evaluation of air defence firing and resuming operations, shows the sequential action of the air defence system, following a workflow model. If during the fight with the air enemy there are more "air defence participants" but each of them makes its own air defence workflow, then we can talk about cooperative action, but if the air defence operating monoposts contribute to achieving the same air defence workflow, each having an "intervention" on a certain work phase, then we talk about an air defence collaborative working.

The concept of air defence collaborative working is a new one, where each element is involved by unique participation on efficiency criteria and timely framing (in space and time) in order to produce the maximum intended "plug-and-fight" effect. The "plug-and-fight" concept, similar to that of "plug-and-play", is the essential part of MEADS, generated by the flexibility of the air defence open structure, which we have identified as one of the important provisions of the air defence capacity of

the 21st century. The open air defence collaborative working MEADS can generate greater firepower on the same mission but with a much lesser waste of forces and equipment than compared to the air defence firing systems of operating monopost type. The sequential work is the one that makes possible to delegate - take over the command and control of the firing subsystem, to and from another air defence procedurally involved control unit, in order to manage the air defence fire of another operating monopost when skipping its own command post.

The MEADS concept, by "plug-and-fight" applicability, provides new knowledge opportunities in the direction of integrating the air defence response systems with obsolete individual capabilities but which, included in a network of collaborative working can have a definitely performance and essential for fighting the air enemy, and it implicitly provides the security of the airspace of responsibility. The character of the air defence artillery firing clearly lies in anticipating actions: what we should do now, in the present stage (based on what happened – the recent past), so that we can accomplish the objectives in the next stage as well (the immediate future), and so on, to get the maximum results in terms of efficiency and fulfillment of mission.

Following the personal endeavour of conceptually tackling the issue of the combat with the air enemy, we intended to highlight the key aspects on the degree of individual and collective involvement of the air defence operational monoposts under the conditions of a tactical development technologically supported by joint action in the variant of cooperation and collaborative working.

In conclusion, we can make judgments on the behavior of certain structures that establish relationships with environmental elements and interact with each other in the competitive context involving actions in several directions, and the results can be surprising in terms of finding a new concept of air defence collaborative working on "plug-and-fight" criteria, on efficiency and best performance. It goes without saying that for any organizational structure that interacts with other similar or different structures, it is primary important to harmonize the internal architecture so it would be able to undertake the information of the external flow and also to make intelligible its



messages transmitted to the outside, to the other partners of the collaborative working (workflow) so that finally an actual security of the airspace of responsibility can be established.

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