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# ANALYSIS OF THE MILITARY APPLICATION OF UNMANNED AIRCRAFT AND MAIN DIRECTION FOR THEIR DEVELOPMENT

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***Abstract***

*Modern military unmanned aerial vehicles (UAVs) are assigned a wide range of functions, for the implementation of which they perform many tasks in various military conflicts. The results of the analysis give them the opportunity to reveal the problems in the use of UAVs, make changes in their functions and tasks and identify areas for further development. At present, this requires the introduction of the achievements of artificial intelligence, the introduction of expert systems and microelectronics on board UAVs, as well as their integration with various other means of conducting armed struggle. At the same time, some of the technological solutions for the creation and improvement of UAVs for military purposes can be applied in the civilian sector.*

## Introduction

One of the most characteristic features of modern military conflicts is the integrated process of using real-time combat information at all hierarchical levels responsible for decision-making.

Military experts from the world's leading aerospace countries are of the opinion [3] that in today's combat environment, reconnaissance unmanned aerial vehicles (UAVs) can solve tactical air reconnaissance and electronic warfare (EW) tasks with greater efficiency, effectiveness and efficiency, than manned aircraft (MA). The advantages of UAVs are manifested to a significant extent in the functions of targeting and correcting artillery fire, in combat control and retransmission (transmission) of signals, in biological, chemical, radiation and meteorological intelligence, without risk to personnel involved in these activities. The term for providing the intelligence received from the UAV to the end user is also shortened, especially in real time.

The basis for the widespread use of UAVs for intelligence was laid in the Vietnam War [3], and their combat use began in 1964, with the beginning of large-scale US hostilities in Vietnam. In particular, as a result of the significant combat losses suffered in US pilots and aircraft, air reconnaissance was launched with the

AQM-34L Firebee UAV, with equipment for photo, infrared and electronic reconnaissance. As a result, in the period from 1964 to 1975, various modifications of this type of UAV performed over the territory of Vietnam and South China a total of 3 435 battlefields, of which 2 873 flights (84%) were successful, with only 4 combat losses %. Not a single US serviceman was killed in all the UAV combat missions.

**Study area**

Modern military UAVs perform a wide range of functions, for the implementation of which they perform many tasks over the territory of hostilities and in the depth of the enemy's position. At the same time, as a result of the development of high technologies and innovations in military affairs, the functions and tasks of UAVs often change, in real time. At present, there is no unified definition and classification of UAVs, but such have the United States, Russia and other developed countries in terms of aviation. For example, in the European classification UAVs are divided into the following classes: micro and mini UAVs; for close action; for action at low altitudes; for action at medium heights; for high altitude action; for long-range operation, for medium-altitude operation with long flight duration; for operation at high altitudes with a long flight duration; shock UAVs [3].

Depending on the range of military UAVs can be divided into tactical, operational-tactical, operational and strategic, and by purpose can be reconnaissance; percussion; multi-purpose (intelligence-strike), for targeting; for correction of artillery fire; for signal retransmission; for REB; for radiochemical intelligence; such as air targets, false targets, etc. [1,3].

According to the mass, UAVs are subdivided into: micro UAVs (<5 kg); mini UAV (5 ÷ 200 kg); medium UAVs (<2 000 kg); large (<5 000 kg) and heavy (> 5 000 kg) [2].

UAVs, on the other hand, are a component of an unmanned aerial system (UAS), which is essentially a target system comprising several UAVs, a ground control and management station, and security facilities [3].

Due to the fact that there is no pilot on board the UAV, the value of this device is significantly lower than that of manned aircraft (ten times or more). According to US experts, the preparation of each pilot for combat aircraft to reach the level of "combat use" costs millions of dollars (7–8 and more) and is commensurate with the value of his aircraft. For this reason, compared in terms of “efficiency/value”, UAVs are significantly superior to manned aircraft.

**Research method**

The material proposes an approach derived from the theory of systems analysis [6], showing the relationship between the functions of UAVs, the tasks associated with the implementation of each of these functions, the results obtained

after the tasks, the analysis of results, problems the tasks, the proposed solutions, as well as the feedback in the logical block diagram with these functions and tasks (Fig. 1). The proposed approach can be defined as functional.

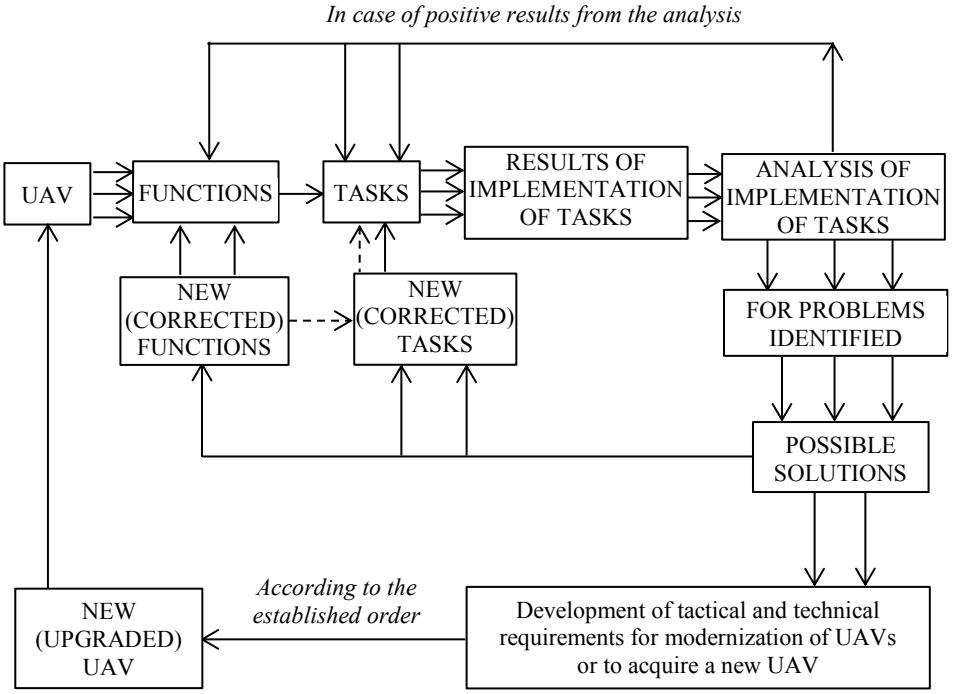


*Fig. 1. Block diagram of application of system analysis for determining the functions and tasks of UAVs*

As can be seen from Fig. 1, in case of positive results from the UAV actions, as a result of analysis, if necessary, the functions and tasks indicated in the upper left corner of this figure are repeated. Otherwise, after an analysis, the problems that have arisen and the possible solutions that have arisen are defined (lower right corner of the figure). In this situation, there are two possibilities. The first is the adjustment of the functions and tasks of UAVs or the formulation of new ones, and the second is the development by a team of diverse specialists of tactical and technical requirements for modernization of UAVs or the purchase (creation) of new UAVs.

The results of the solved tasks with the help of UAVs are evaluated on the following three-point scale:

- complete success: the task is completed;
- partial success: the task is partially completed;
- without success: the task is not completed.

**Military conflicts with the active participation of UAVs**

This material is the study of the battle using UAVs in the war in Lebanon in 1982, in "Operation Desert Storm" in Iraq in 1991, in "Operation Allied Force" in Yugoslavia in 1999, "Operation Enduring Freedom" in Afghanistan in 2001, the military action in Syria (2014 ÷ 2020) and the military action in Nagorno-Karabakh in the autumn of 2020.

***The Lebanon War, 1982.*** During the Syrian-Israeli conflict in Lebanon, both countries actively used UAVs, mainly to solve air reconnaissance tasks. During the war, a new class of UAVs appeared – small UAVs, which due to their size are weakly vulnerable to missile air defense systems (ADS). New ways of conducting combat operations, respectively, new functions of UAVs appear, for each of which specific tasks are formulated and set.

The results of the implementation of the functions and the tasks solved by the UAV in Lebanon are shown in Table 1.

*Table 1. Functions and tasks solved during the fighting in Lebanon by the Israeli UAV (1982)*

| № | Function | Tasks solved | Results | Problems |
|---|---|---|---|---|
| 1. | Air recon-naissance | - collection of information on objects of the defense infrastructure;<br>- control of the results of the blows to the enemy. | Complete success | Strong enemy air defenses |
| 2. | Targeting | - transmission from the UAV board in real time of data for the purposes. | Complete success | Strong enemy air defenses |
| 3. | Artillery fire adjustment | - control of strikes on enemy targets and adjustment of artillery fire. | Complete success | Strong enemy air defenses |
| 4. | ***New:*** Complicating the air situation | - imitation by UAV on a flight of combat aircraft;<br>- use of new tactics - small UAVs in "Birds in a flock". | Complete success | Strong enemy air defenses |
| 5. | ***New:*** Demonst-rative (distracting) | - to mislead operators of radar stations (RS);<br>- radar stations to go into combat mode;<br>- unmasking of air defense funds;<br>- lifting the enemy's fighters into the air, as a result of which they waste their fuel aimlessly. | Complete success | Need for modeling air attack on enemy sites |

During the operation on June 10, 1982, the Israeli aviation used the small-scale Scout and Mastiff UAVs on a large scale, using the "Birds in a flock" tactic.

In this tactic, UAVs fly in large groups at low altitudes, thereby misleading radar station (radar) operators that manned aircraft are approaching them. These groups of UAVs complicate the air situation for air defense and aviation [1, 3].

The intelligence information from the UAV board arrives at the land management points in real time and with great accuracy for the coordinates of the targets. These data are extremely important for the implementation of functions № 1, 2 and 3 of Table 1.

Following the implementation of function № 4, as a result of the demonstrative (distracting) function of the Israeli UAVs (function № 5 in Table 1), the Syrian operators switched the radar statin to combat mode, whereby the stations and Anti-Aircraft Missile Complex (AAMC) became "visible" to the Israeli aviation. The Syrian fighter jets raised in the air meet no enemy and, after running out of fuel, return and land at the airports for bases. In the next moment, the Israeli strike aircraft, in the absence of resistance from the Syrian fighters, took to the air, bombing and rocketing aircraft. During this operation, 18 AAMC batteries and 86 aircraft were destroyed [4, 5], which changed the outcome of the war.

***Operation Desert Storm, Iraq, 1991.*** For the first time, the Multinational Force Command (MNC) uses different types of UAVs to conduct air reconnaissance – the American Pioneer, Pointer, Shadow-600 and the French Mart. At the same time, their implementation is considered limited for reasons of a different nature. The results of the implementation of the functions and the tasks solved by the UAV of the MNC in Operation Desert Storm are shown in Table 2.

*Table 2. Functions and tasks solved by the MNC UAV in Operation Desert Storm (1991)*

| № | Function | Tasks solved | Results | Problems |
|---|---|---|---|---|
| 1. | Air reconnaissance | - collection of information on objects of the defense infrastructure;<br>- control of the results of the blows to the enemy. | Complete success | - extremely large amount of intelligence information;<br>- difficult coordination of data from different intelligence sources;<br>- low reliability of UAV sensors. |
| 2. | Artillery fire adjustment | - control of strikes on enemy targets and adjustment of artillery fire. | Complete success | |
| 3. | Complicating the air situation | - launching "false targets";<br>- change of heights for UAV use. | Complete success | |
| 4. | **New:** Strike at ground targets | - destruction of a mobile radar station by a Predator UAV armed with a radar warhead. | Incidentally | Simultaneous solving of a reconnaissance-strike task by one UAV |

* Incidentally: The task is performed for the first time or experimental.

In the course of hostilities against Iraq, in the interests of the ground forces and the Marines, UAVs were deployed and used on foreign territory, each of which included 4 to 5 RQ-2 Pioneer UAVs.

The analysis of the fighting in Iraq shows the active use by the French armed forces of the "Mart" UAV, based on the territory of Saudi Arabia. They mainly perform tasks of monitoring, targeting, correcting artillery fire, conducting air reconnaissance at the operational and tactical level. At the beginning of the offensive operation, the French UAVs were operating at an altitude of 300 m. What is new in the process of combat operations is the change of the echelons for the use of "Mart" UAVs, and in order to avoid a collision with the strike aircraft, the flight altitude of the UAV is reduced to 150 m (functions № 1, 2 and 3 of Table 2).

***Operation Allied Force, Yugoslavia, 1999.*** Different types of UAVs are involved in this operation in five of the participating countries. For a long time, low clouds remained in the area of hostilities (March and April), which did not allow the optoelectronic reconnaissance satellites in orbit to provide the necessary information. This necessitates the successive launch and use of several UAVs to ensure a continuous flow of intelligence.

In Kosovo, UAVs are used at medium altitudes, provide a constant flow of information for the movement of Serbian armored vehicles and solve the following main tasks: reconnaissance of the group of troops in the plains and the routes for their movement; detection and tracking of mobile AAMCs and radars; reconnaissance of the results of air strikes on sites; targeting, for which three Predator UAVs are equipped with laser targeting and guidance systems.

The results of the performance of the functions and the tasks solved by the UAV during the fighting in Yugoslavia in 1999 are shown in Table 3.

In the course of the operation, failures also occur as a result of impaired interaction and incomplete training of the operators. In particular, an operation is planned (function № 4 in Table 3), in which a US UAV must perform aerial reconnaissance over the territory of Kosovo, transmitting the information to a British UAV flying over the territory of Macedonia, and from there to a ground center for management. The actions of the American and British UAV operators, due to the heavily rugged terrain and the complex meteorological situation, do not ensure the flow of information to the ground control center.

In Operation Allied Force, about 500 flights with a total duration of 3 800 h were completed. Depending on the intensity of the strikes, there are from one to four UAVs in the air over the territory of Yugoslavia at the same time. During the entire period of hostilities, 27 UAVs were lost, six of which suffered accidents [1, 5]. The US and NATO commands acknowledge the high efficiency of the use of UAVs in Operation Allied Force, in contrast to satellite surveillance systems.

*Table 3. Functions and tasks solved during the hostilities in Yugoslavia by the UAVs of the opposing states (1999)*

| № | Function | Tasks solved | Results | Problems |
|---|---|---|---|---|
| 1. | Air reconnaissance | - collection of information on objects of the defense infrastructure;<br>- control of the results of the blows to the enemy; | Complete success | - bad weather (low clouds);<br>- icing of UAVs;<br>- rugged terrain of the battle zone;<br>- high humidity. |
| | | - detection and tracking of mobile AAMCs and radars. | Partial success | |
| 2. | Targeting | - transmission from the UAV in real time of data for the purposes, including through laser devices. | Partial success | |
| 3. | Weather reconnaissance | - gathering specialized information over the enemy′s territory. | Partial success | |
| 4. | Retransmit data | - planning of 2 UAVs in one mission, respectively over Kosovo and over Macedonia, for retransmission of information to a ground control center. | Failure | - insufficient training of operators. |

***Operation Enduring Freedom in Afghanistan, 2001.*** This anti-terrorist operation operation uses, for the first time, the control of a Global Hawk UAV by satellites in orbit around the Earth. The operations of this UAV in the operation are limited to several fields and are related to ensuring the combat operations of the US Armed Forces in Afghanistan. The analysis of the use of the Global Hawk UAV in the operation shows that the main complexity lies in the management of their flight, which requires the presence of three free satellite communication lines. [2, 4].

In the course of the operation, the RQ-1 Predator UAV was used for the first time in a reconnaissance strike, directly striking ground targets with remote-controlled anti-tank missiles, air-to-surface class, Hellfire-C and Hellfire-K. The first target is a moving truck of terrorists, as the operator remotely directs the missile from the ground. Thus, including in conjunction with US Air Force strike aircraft, several dozen strikes were inflicted on mobile and stationary targets with high accuracy of hits.

A new UAV counter-terrorism function is also emerging in the fighting in Afghanistan, including the protection of convoys and the warning of terrorist attacks.

An analysis of the experience of using the Predator UAV in Afghanistan shows that its combat capabilities are limited at both high and low ambient temperatures. Low temperatures cause freezing and icing of the aircraft, and at high temperatures, for example, at t° = + 38°C of ambient air, the start of the UAV should be done in the next 5 ÷ 10 min. Otherwise, the UAV is not able to perform

the combat task, as the temperature of the air inside it reaches t° = + 66 °C, and at such a temperature the reconnaissance equipment cannot work normally [5, 7].

An analysis of UAV operations in Afghanistan shows that of the three lost Predator UAVs, at least two are due to icing. Such a problem was already known during Operation Allied Force in Yugoslavia in 1999 and during the fighting in the Bosnian region. Table 4 shows the functions and tasks solved by American UAVs in anti-terrorist operation in Afghanistan in 2001.

*Table 4. Functions and tasks solved during the actions in Afghanistan by American UAVs (2001)*

| № | Function | Tasks solved | Results | Problems |
|---|---|---|---|---|
| 1. | Air recon-naissance | - collection of information on objects of the defense infrastructure;<br>- control of the results of the blows to the enemy; | Partial success | - bad weather (low clouds);<br>- high humidity;<br>- extremely high and low ambient temperatures;<br>- conditions for icing of UAVs;<br>- significant resource required (free channels) for satellite communication with the Global Hawk UAV;<br>- insufficiently good training of UAV operators. |
| 2. | Targeting | - transmission from the UAV in real time of data for the purposes, including through laser devices. | Partial success | |
| 3. | Weather recon-naissance | - gathering specialized information over the enemy′s territory. | Complete success | |
| 4. | **New:** Anti-terrorist | - hitting terrorist targets on the ground using guided anti-tank missiles;<br>- protection of convoys from terrorist actions;<br>- a warning of an attack by terrorists. | Partial success | |

Several other Predator UAVs were lost in Afghanistan due to insufficient operator training. Landing of UAVs of this type turns out to be a rather complex task and is performed by the operator manually, as UAVs during this period still do not have an automatic takeoff and landing system. This imposes the conclusion of the need for high professional training of UAV operators in peacetime.

***Military action in Syria, 2014 ÷ 2020***. According to the Chief of the General Staff of the Armed Forces of the Russian Federation, 60 ÷ 70 flights of Russian UAVs are performed daily in the skies over Syria. The main functions performed by UAVs are: air reconnaissance, electronic countermeasures (ECM), targeting and correcting artillery fire and air strikes.

With the help of UAVs, the so-called “reconnaissance and strike contours” are created, with the help of which control over the territory of Syria is ensured [10]. This control is also carried out by the deployed satellite group of Russia, and in order to clarify the characteristics of the detected targets by the satellites, the Russian UAVs conduct post-satellite reconnaissance.

*Table 5. Functions and tasks solved by Russian and Turkish UAVs, as well as UAVs of Islamists during the fighting in Syria (2014 ÷ 2020)*

| № | Function | Tasks solved | Results | Problems |
|---|---|---|---|---|
| | Russia | | | |
| 1. | Air reconnaissance | - collection of information on objects of the defense infrastructure;<br>- control of the results of the blows. | Complete success | Difficulties in aerial identification of terrorist structures |
| 2. | Targeting | - transmission from the UAV in real time of data; | Complete success | |
| | | - creation of "reconnaissance-strike contours". | Partial success | |
| 3. | Artillery fire adjustment | - control of strikes on enemy targets and adjustment of artillery fire. | Partial success | |
| 4. | **New:** Anti-terrorist | - collecting information on the movement of terrorist structures;<br>- liquidation of terrorist leaders and manpower;<br>- ECA of terrorists′ UAVs, control of their control and deviation from their targets;<br>- destruction of UAVs by terrorists from AAMCs, covering relevant sites. | Complete success | |
| 5. | **New:** Post-satellite reconnaissance | - specification of parameters of detected targets by intelligence satellites;<br>- clarification of the location and type of mobile and stationary targets detected by the satellites. | Complete success | |
| | Turkey | | | |
| 1. | Air reconnaissance | - collection of information on objects of the defense infrastructure;<br>- control of the results of the blows. | Complete success | Difficulties in aerial identification of terrorist structures |
| 2. | Targeting | - real-time transmission of data for purposes, including with laser devices. | Complete success | |
| 3. | **New:** Anti-terrorist | - collecting information on the movement of terrorists;<br>- defeating mobile targets with terrorist leaders and manpower;<br>- defeat armored targets. | Complete success | |
| | Islamic State terrorists | | | |
| 1. | Strike at ground targets | - destruction of ground targets, including "Birds in a flock". | Partial success | Strong air defense and ECM |
| 2. | Targeting | - directs a suicide bomber;<br>- records the events. | Partial success | Overcoming ECM |

Turkish UAVs are constantly patrolling the skies over northern Syria, with the Bayraktar TB-2 being particularly active. On a daily basis, one of these UAVs either hits a target or refines its location and directs F-16 or strike helicopters.

Table 5 shows the functions and tasks of UAVs in Syria. Terrorists in Syria use hand-made or modernized UAVs and apply modern targeting and control technologies (groups of 10 ÷ 15 UAVs, including "Birds in a flock"). In this sense, of interest is [8, 10] the massive use by terrorists against an air base and a naval checkpoint of the Russian Air Force in Syria of 13 UAVs with ammunition on board on the night of the 5th against the 6th of January 2018. As a result, these air targets were detected by the air defense system, and 7 of them were destroyed by the Panzer C1 AAMC. The remaining 6 UAVs were taken under control, as 3 were forcibly landed outside the territory of the concealed sites, and the other 3 detonated in a collision with the ground.

Recently, Islamic State (ISIL) operators have used a scheme in which a UAV indicates the target and directs a suicide bomber to the target vehicle, in which the drone controls the process and records events for propaganda use [7, 10].

***The military operations in Nagorno-Karabakh in the autumn of 2020.*** In these actions, Azerbaijan widely uses strike UAVs and with their help a new model of combat operations in a local military conflict is being tested.

The main approaches to UAV operations in Nagorno-Karabakh by the Azerbaijani army are diverse. In the first place, strong and prolonged strikes by various types of UAVs are methodically applied, together with artillery and surface-to-surface missiles. Secondly, unmanned barrage ammunition (single-action) is used, as well as reconnaissance and strike UAVs for tactical purposes, equipped with high-precision ammunition with small dimensions.

Azerbaijan′s main air strike force consists of the Bayraktar TB-2 UAV, presumably operated by Turkish operators with significant combat experience in Libya and Syria. Used in conjunction with barrage ammunition, these UAVs have become an effective means of destroying tanks, vehicles and artillery and air defense equipment of the Armenian army. According to some data, the Bayraktar TB-2 UAV destroyed more than 60 T-72 tanks, others about 20 armored vehicles, 11 self-propelled howitzers, 5 Radar stations, 20 pcs. AAMC launchers, separate C-300 AAMC launchers, etc. [10].

The combat use of all types of UAVs in the operations in Nagorno-Karabakh clearly proves that the detection and destruction of targets with a low effective reflecting surface, such as unmanned barrage ammunition, is a difficult task for modern air defense systems.

On the other hand, Bayraktar TB-2 reconnaissance UAVs demonstrate medium-altitude tactics with small-scale high-precision weapons fired outside the air defense units of the ground forces. In practice, this allows UAVs to wage a "contactless" war, without human casualties, at relatively modest financial costs.

The success of the Azeri UAVs has been achieved mainly in the relatively flat areas. With the onset of autumn fogs and low clouds, the use of UAVs is severely limited in the mountainous and semi-mountainous and forested areas of Nagorno-Karabakh.

Table 6 shows the functions and tasks of UAVs in Nagorno-Karabakh (autumn, 2020).

*Table 6. Functions and tasks solved by Azeri and Armenian UAVs during the fighting in Nagorno Karabakh (autumn 2020)*

| № | Function | Tasks solved | Results | Problems |
|---|---|---|---|---|
| | Azerbaijan | | | |
| 1. | Air recon-naissance | - collection of information on objects of the defense infrastructure;<br>- control of the results of the blows to the enemy. | Complete success in the plane part | Complex meteorological situation in the mountains |
| 2. | Targeting | - targeting high-precision weapons with small dimensions;<br>-management of unmanned barrage ammunition. | Complete success in the plane part | Overcoming the enemy′s air defenses |
| 3. | Recon-naissance & strike at ground targets | - reconnaissance and execution of effec-tive strikes within one flight of a UAV;<br>- use of UAVs in conjunction with artillery and surface-to-surface missiles;<br>- launching UAV weapons outside the air defense zone. | Complete success in the plane part | |
| | Armenia | | | |
| 1. | Air recon-naissance | - collecting information to move the enemy;<br>- control of the results of the blows to the enemy. | Without success | Unable to fight barraging ammunition |

While Azerbaijan uses mainly Israeli and Turkish UAVs, as well as its own production under an Israeli license, Armenia opposes several dozen UAVs, entirely its own development. They are far behind the Azeris, both in terms of technology and their number in the area of hostilities. The incidental use of Armenian UAVs is limited to a few reconnaissance fields.

The analysis of the fighting in Nagorno-Karabakh in the autumn of 2020 confirms the reconnaissance and strike function of the UAV with the ensuing relevant tasks. In particular, UAVs are increasingly performing integrated in-flight reconnaissance and strike functions, capable of carrying a variety of weapons or

being used as “guided missiles”. After being used for the first time in Syria, the use of “kamikaze drones” is also confirmed here.

**Main directions for UAV development**

The analysis of the combat operations with the participation of UAVs in the military conflicts discussed above provides an opportunity to formulate the main directions for their development. These should be related to the introduction of the achievements of robotics, artificial intelligence, on-board expert systems, algorithms for “Birds in a flock”, as well as integration with other various means of armed struggle [2], in the context of ongoing miniaturization of UAVs.

The main directions for the development of military UAVs are specified according to their purpose.

***UAV for reconnaissance and targeting.*** First of all, their development requires the implementation of complex reconnaissance with various sensors, including on-board radars with synthesized aperture, as well as improving the quality of algorithms in the program for flight control of UAVs in the respective modes, towards increasing autonomy and successful targeting.

Secondly, it is necessary to work on improving the programs and methods for coding radio signals, to create a “chaotic change of frequencies”, to use different modulations of the signal, etc., in order to maximize the difficulty of the opposing side.

The next direction is aimed at the development and improvement of data exchange systems with other aircraft and ground control points, the surveillance cameras used by UAVs and the image recognition algorithms. It is believed that UAVs will be able, observing the gathering of many people, to detect even suspicious persons and the presence of explosives, small arms and more dangerous objects [8].

***UAV for strikes on targets.*** First of all, it is necessary to continue improving and developing the management of ammunition and high-precision UAV weapons used for strikes on land and sea targets. The modernization of the technologies and the element base will allow reducing their mass, to create light enough “smart” ammunition for UAVs with self-targeting systems.

Secondly, specialized UAVs (for example, the deck X-47A) with a high degree of invisibility should be used to break through the air defense system, which, after hitting the targets, should transmit information in a protected from interference mode to the following strike aircraft. To increase the strike capabilities of UAVs, some manufacturers are increasing the amount of ammunition on board. For example, China is building the world′s largest UAV, capable of carrying up to 24 air-to-ground missiles and staying in the air for up to 60 hours [10].

***UAV for electronic warfare.*** It is necessary to improve the methods and techniques for electronic warfare in complicated air conditions, as well as the creation of false targets in the process of using UAVs.

***Use of UAVs as air control points.*** Experts believe that equipping UAVs with computer systems with artificial intelligence (expert systems) will improve their security [2]. It is considered that in case of disruption or disconnection of the operator, such UAVs will be able to independently detect and identify objects, use the means of destruction and perform other independent actions.

***Use of UAVs for logistics deliveries.*** The development of UAVs shows that a new UAV function can be established. For example, in modern military conflicts, the importance of small reconnaissance and sabotage groups of Special Forces, which periodically need to supply ammunition and material resources, is growing.

The listed UAVs for different purposes can be configured as convertibles.

***Use of aerospace UAVs.*** Based on the X-37B aerospace UAV with a high degree of robotics, which has successfully completed several flights in the current decade, in the period until 2035 it is planned to produce and accept weapons in the US Air Force of several X-37B unmanned spacecraft [9]. They provide fast access to space and solve a wide range of tasks, among which the leading ones are reconnaissance and satellite inspection.

The analysis of the military applications of UAVs allows to formulate the main directions for the development of unmanned aerial vehicles for civil (commercial) purposes, such as: monitoring (surveillance and control) of the critical infrastructure of the country, mainly energy and transport; early detection of natural disasters (floods, fires, earthquakes, etc.) and man-made accidents, as well as damage assessment; independent control of the radiation situation in the Nuclear power plant area (s); monitoring of marine areas; assessment of environmental losses from various pollution and cataclysms; information provision of search and rescue operations; delivery of goods in hard-to-reach places; control of traffic on highways; cadastral survey of regions on the territory of the country; medical care, etc. The most serious problem in these cases is of a legal nature. In order to obtain the status of civil aircraft, each of the types of UAVs must pass the certification procedures in accordance with the airworthiness standards in force in the country.

## Conclusion

The new functions and tasks of the UAV analyzed in the material require the respective scientific and engineering-technical researches and substantiations. According to some authors, in the coming decades, UAVs will replace manned aircraft. Obviously, a balance should be sought between these two types of aircraft.

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## АНАЛИЗ НА ВОЕННОТО ПРИЛОЖЕНИЕ НА БЕЗПИЛОТНИТЕ ЛЕТАТЕЛНИ АПАРАТИ И ОСНОВНИ НАПРАВЛЕНИЯ ЗА РАЗВИТИЕТО ИМ


***Н. Загорски***



### Резюме

На съвременните военни безпилотни летателни апарати (БЛА) се възлагат широк спектър от функции, за реализацията на които те изпълняват множество задачи в различни военни конфликти. Резултатите от анализа им дават възможност да се разкрият проблемите по използването на БЛА, внесат изменения във функциите и задачите им и се набележат направления за по-нататъшно развитие. Понастоящем това налага въвеждане на постиженията на изкуствения интелект, внедряването на експертни системи и микроелектро-ника на борда на БЛА, както и интегрирането им с други разнообразни средства за водене на въоръжена борба. Едновременно с това част от техно-логичните решения за създаване и усъвършенстване на БЛА за военни цели могат да бъдат приложени и в гражданския сектор.