Applied problems of information systems operation

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A. Artemenko [1], O. Strutsinskiy[2], O. Lukashuk[3], O. Biesova [3]

[1] General Staff of the Armed Forces of Ukraine, Kyiv, Ukraine
[2] Military unit 2533, Dnipro, Ukraine
[3] Ivan Kozhedub Kharkiv National Air Force University, Kharkiv, Ukraine

FEATURES LOCATIONS HELICOPTER IN COASTAL AREAS

Abstract. The purpose of the article. Consider method by which calculated required detection range helicopter that can provide guidance for fighter destroyed helicopter. It is believed that ensured detection helicopter radio equipment, which provide the work of the command post. **Results.** The article analyzed the trend of improving helicopters in recent years. The noted a growing possibility of using the helicopter to meet the challenges on the battlefield, putting helicopters in a row with means of attack, using airborne equipment. The conclusion that the fight against helicopters important issue is the calculation time required for a decision on their application at the command post defense. In the article, the example of an automated system of decision-making at the command post Brigade tactical aviation airfields considered the possibility of using the proposed method and the calculations detection range, providing decision by the person who decides brigade of tactical aviation. **Conclusions.** It is shown that one of the key conditions for the organization and the successful interception of enemy helicopters are grounded and timely decisions on management of fighter aircraft on the remote control of Air Force tactical level. Uncertainty and dynamism of the airspace, time constraints, significant amounts of information and uncertainty that characterize the actions of enemy helicopters that are clearly uncertain and contradictory, causing growth requirements for the feasibility and the efficiency of decision-making on the Air Force control panel of the tactical level. One of the directions of fulfilling such requirements is automation of the processes of management of fighter aviation at the stage of combat operations.

Keywords: radar channel command post; radar detection; low-altitude target coherence signals fighter aircraft; control point.

Introduction

Problem statement. Analysis of the trend of improving helicopters [1] indicates that in recent years firepower helicopters significantly increased. Previously only used helicopters to transport rapid reaction units, evacuating the wounded from hospitals and other transportation problems, now they can be used as a means of air attack. The strengths of modern helicopters, as shown in [2-6], include their high mobility and the related possibility of the battlefield unexpectedly due to various shelters, which dramatically reduce the effectiveness of air defense. Availability helicopter devices that provide flights in difficult weather conditions, day and night, as well as effective systems onboard weapons poses a helicopter in some of the most dangerous means of air attack of the enemy. The organization air defense struggle becomes the most important series of events. According to the authors of [7-9] organization air defense fighting is most effective when destroying helicopters on the far outskirts of the protected object. The most effective means of destroying helicopters have fighter aircraft. The use of aircraft, in turn, effectively when using automatic guidance systems of fighter aircraft to the target. The use of automated guided fighter aircraft at the target requires some time required person decision making cycle to provide guidance on the fighter helicopter. In the known works of the present time there is no method of calculating the time required for a decision to exterminate helicopter person who decides at the command post air defense.

Analysis of recent research and publications. The use of helicopters at low altitudes in turn for radars usually impose stringent requirements for rate of delivery of information about the target environment [10–24]. This equally applies to both radar stations civil systems (flight control and landing, aircraft collision avoidance), and military applications. Quite widespread use of such radars found in systems and complexes air defense. Saturation of the armed forces leading nations attack helicopters with a range of 260 to 1000 kilometers allows to strike the entire depth of construction of opposing forces [10, 11]. This shows the urgent need to construct special facilities and means of combat attack helicopters [2-6]. Of particular relevance, this problem takes in the coastal areas and the locations of large masses of water (reservoirs, lakes, estuaries, etc.) where helicopters can operate not only small, but on micro altitudes [25].

Under these conditions, as shown in [2-6], successfully fighting helicopters possible by carefully organized intelligence [10, 11] for the purpose of timely detection of aircraft and alert troops about their approach. Most effective in fighting helicopters are considered Intelligence and destroying low-altitude targets that have the lowest response time on appearance goals, as well as the ability to quickly and easily identify open fire.

According to [10, 11] key requirements that apply to intelligence in favor of combat helicopters should consider early detection of the air to remote, ensuring their timely identification and production of weapons systems for combat, opening their fire on the marginal range, and timely detection of approaching the likely routes, areas and lines of transition to the attack. It must be borne in mind that for each weapon system that can be used for combat helicopters, has its own required detection range of the

aircraft, depending on the range of the weapon and the time required for identification purposes and to bring weapons on alert. Since the enemy's helicopters can carry an adversary (attack) in virtually any direction, then their intelligence should be circular, to ensure timely discovery of effective fire in any direction. To destroy helicopters enemy can be used missiles, aircraft, artillery, small arms, mine-explosive obstacles, flamethrower-inflammatory agents, anti-aircraft weapons (anti-aircraft missiles, guns, machine guns) and air troops, raid teams and specially selected units of different genera troops. The question of the use of one or another means to reduce enemy helicopters in each particular case is usually decided at the command post by the decision maker.

Away helicopters tactical [9] and operational-tactical missiles can be applied to the depth order of battle and rapid construction. Fighter-bomber and fighter aircraft [2-6], unlike missiles capable of independently find and immediately destroy enemy helicopters visually visible on platforms and in the air, in simple and adverse weather conditions, day and night. However, the most effective attacks on enemy helicopters based on received advance intelligence. In the absence of such data fighter-bombers carried out to search and destroy enemy helicopters in both its location and its territory.

The most effective method is automated guided fighter [9]. In particular, for the automated guidance of a helicopter fighter, the proposed use of the proposed [9] information exchange method between elements of the control system - the radar data processing station, the point of guidance of the radar station of the combat control system of the fighter aviation, and the starting command posts with the control point of the Air Force of the tactical level [9]. Obviously, the conditions for the operation of the radar system of the combat management system and their tactical and technical characteristics largely determine the quality of information to perform operational and tactical calculations for intercepting fighter helicopters.

At the implementation of the developed method, the launch command posts of the airfields of the tactical aviation brigade provide a combat command line billing with information on the implementation of the instructions for the transfer of fighters at specified levels of combat readiness, on the state of aircraft and pilots.

Location of transfer stations teams on the ground, the impact of natural phenomena on the propagation of radio waves and other factors determine the area prompting helicopters and actually intercept fighters.

Flying fighter in the settlement trajectory, compliance with the safety, timely detection of helicopters, getting into position, convenient for carrying out a helicopter approach and attack are possible only after the prompt adoption of reasonable decisions at the tactical level control point at the helicopter fighter's interception.

A common tool specially designed to detect helicopters and other air targets in flight is radar station reconnaissance systems, command and control [9, 26]. However, their ability to detect targets greatly reduced with decreasing altitude helicopters, especially invert rough areas. Practice shows that the helicopters flying at an altitude of 100 m., radar reconnaissance means in terms of sight can detect targets at a distance of 10 - 25 km, at an altitude of 25 meters - at a distance of 5-15 km and a height of 15 m - only at a distance of 5-7 km. When contour helicopter flight while they were in sight of a rather short, which further complicates their timely detection and recognition. To address this shortcoming used together different types of radars, including possessing different characteristics and abilities. Positions radar should be chosen so that detection provided on the marginal range of helicopters, especially the most probable direction of their flight, because forests along river beds and valleys with gorges. It follows from [9] for a decision on the appointment of a fighter to destroy helicopters, it is necessary for a certain interval of time. Since in the well-known literature there is no methodology for calculating the required time for decision-making by the decision maker at the command post of the air defense, this article eliminates this shortcoming.

The purpose of the article: Consider method by which calculated required detection range helicopter that can provide guidance for fighter destroyed helicopter. It is believed that ensured detection helicopter radio equipment, which provide the work of the command post.

Main material

We estimate interval (t_{tm}) to make a decision at the command post of the Air Force tactical level based on the approach proposed in [9].

The value of time for a decision t_{tm} depends on early decisions related item management speed helicopter flight time and fighter approaching the turn of the performance of tasks [9]:

$$t_{tm} = \left(R_1 - R_2\right)/V_C \qquad (1)$$

where R_1 – implemented milestone decision at the command post; R_2 – milestone decision on the use of fighter aircraft; V_C – speed target (helicopter).

$$R_1 = D_{upd} - V_C \cdot t_{rtv}, \qquad (2)$$

where D_{upd} – detection range helicopter units advanced radar troops; t_{rtv} – the total working time of the control unit of the unit, part, subdivision of the radio troops.

$$R_2 = d + V_C \cdot (t_{com} + t_{пол}), \qquad (3)$$

where d - far turn limit the introduction into battle fighter; t_{com} - cycle management; $t_{пол}$ - time of flight to the area of a combat mission.

Draw analysis cycle management, i.e. the length of time during which consistently carried out management tasks from the receipt of the combat mission by the end of their performance in the system management [9]. Using the characteristics of air strikes conducted by NATO Air Force joint offensive operations in recent years [2-6] was obtained by the length of time that is

available to the decision maker for the analysis of air situation and making recommendations. This interval is $t_{tm} = 0{,}16$ ... 10,23 min. This expectation life time decision to subordinate the management of forces and means will $M^*(t_{tm}) = 5.195$ min. Define confidence interval (I_β), for values $M^*(t_{tm})$. To build I_β, corresponding confidence probability β, we find value estimation variance $\overline{D}$ [9]:

$$\overline{D} = \left(\sum_{i=1}^{n} t_{tm(i)} \Big/ n - M^*(t_{tm}) \right) \cdot \frac{n}{n-1}, \qquad (4)$$

where n – number of elements $t_{tm(i)}$.

We find this value ε_β, for which

$$P\left(\left| M^*(t_{tm}) - M(t_{tm}) \right| < \varepsilon_\beta \right) = \beta \ . \qquad (5)$$

Then with a given probability β value $M^*(t_{tm})$ fall into the interval:

$$I_\beta = (M^*(t_{tm}) - \varepsilon_\beta; \quad M^*(t_{tm}) + \varepsilon_\beta) \ . \qquad (6)$$

In solving the tasks of processing statistical recommended value β choose from a range [0.9; 0,999]. Then the confidence interval for $M^*(t_{tm})$ is:

$$I_\beta = (2.23; 8.18). \qquad (7)$$

In the evaluation of the efficiency of decision-making in the appointment action fighters in helicopters determined that the likelihood of a decision by the time that will ensure its implementation and the possibility of issuing appropriate orders to subordinates capabilities, is according to the expression $P_{op}(T_{req}) = 1 - e^{-\lambda t_{tm}}$.

The audit showed that the experimental data are consistent with the hypothesis that a random variable T_{req} has an exponential distribution law.

Find the value of χ^2:

$$\chi^2 = n \sum_{i=1}^{N} (p_i^* - p_i)^2 \Big/ p_i \ \approx 0{,}129 \ .$$

The number of degrees of freedom r in this case is the number of values of the random variable minus the number of overlapping connections $r = 7–2 = 5$. Finds $r = 5$ and $\chi^2 \approx 0{,}129$, $p = 0.95$.

Because $p = 0.95 > 0.01$, the hypothesis of exponential distribution law of a random variable does not contradict the experimental data. The analysis indicates that for a combat mission takes to the length of time t_{tm}, which is at the disposal of the person who makes the decision for the analysis of the air environment and making appropriate recommendations to satisfy demand $t_{tm} \le 10$ min. As the ratio of (1.1) to satisfy this requirement the person who makes the decision should have available information on speed targets $V_ц$ and to receive information about the availability of helicopters for advanced units of radio troops on a range $D_{общ.}$, which provides the implemented boundary for the decision on the remote control R_{VS}^P. As shown in [1, 9], precision measuring of coordinates and parameters to be no worse than the corresponding precision measuring these parameters on the radar command and control systems within the range of sight. As follows from the ratio (2), the boundary of the decision making on the control panel is realized, considering that in the implementation of the automated decision-making system for the presence of the target on the control panel of the compound, parts, units of radio troops, it can be considered equal to the distance of detection of helicopters by the advanced units of radio troops, that is $R_{VS}^P \approx D_{det}$. In turn, using equation (1), (2) and (3) easy to show that

$$D_{det} \approx t_{tm} \cdot V_C + R_{VS}^P \ . \qquad (8)$$

According to [1-6, 9] analysis of the fighter aircraft to repel air strikes showed that the range boundary decision on the use of aircraft must meet requirement $R_{VS}^P \ge 50$ km. Given that modern helicopters speed it satisfies $V_C \sim$ 240-270 km/h (Mi-28N, Mi-35M, Mi-8, Ka-226, Ka-27PS) and $V_C \sim$ 300-320 km/h (Mi-24, Mi-35M, Ka-52, Ka-50), using (8), we find that when $t_{tm} \sim 10$ min., the range of detection of helicopters by advanced units of radio troops must meet the requirements $D_{upd} \ge 100$ km.

Conclusions

It is shown that one of the key conditions for the organization and the successful interception of enemy helicopters are grounded and timely decisions on management of fighter aircraft on the remote control of Air Force tactical level. Uncertainty and dynamism of the airspace, time constraints, significant amounts of information and uncertainty that characterize the actions of enemy helicopters that are clearly uncertain and contradictory, causing growth requirements for the feasibility and the efficiency of decision-making on the Air Force control panel of the tactical level. One of the directions of fulfilling such requirements is automation of the processes of management of fighter aviation at the stage of combat operations.

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ВІДОМОСТІ ПРО АВТОРІВ / ABOUT THE AUTHORS

Артеменко Артур Миколайович – кандидат технічних наук, начальник Головного управління Генерального штабу Збройних Сил України, Київ, Україна;
Artur Artemenko – Candidate of Technical Sciences, Chief of the General Directorate, General Staff of the Armed Forces of Ukraine, Kyiv, Ukraine;
e-mail: artemenko.arther@gmail.com; ORCID ID: http://orcid.org/0000-0001-7716-0406

Струцінський Олег Васильович – командир в/ч 2533, Дніпро, Україна;
Oleh Strutsinskiy – commander of military unit 2533, Dnipro Ukraine;
e-mail: sxidpvk@ukr.net; ORCID ID: http://orcid.org/0000-0002-6175-7678

Лукашук Олена Вячеславівна – кандидат технічних наук, доцент кафедри фізики та радіоелектроніки, Харківський національний університет Повітряних Сил, Харків, Україна;
Olena Lukashuk – Candidate of Technical Sciences, Associate Professor of the Department of Physics and Radio Electronics, Kharkiv National Air Force University, Kharkiv, Ukraine;
e-mail: dlyavac@ukr.net; ORCID ID: http://orcid.org/0000-0001-8721-2433

Бєсова Оксана Василівна – кандидат технічних наук, старший науковий співробітник наукового центру Повітряних Сил, Харківський національний університет Повітряних Сил, Харків, Україна;
Oksana Biesova – Candidate of Technical Sciences, Senior Research of the Air Force Scientific Center, Kharkiv National Air Force University, Kharkiv, Ukraine;
e-mail: bytko75@ukr.net; ORCID ID: http://orcid.org/0000-0001-7744-1339

Особливості локації вертольотів у приморських районах

А. М. Артеменко, О. В. Струцінський, О. В. Лукашук, О. В. Бєсова

Анотація. Мета статті. Розглянути метод, за допомогою якого розраховується необхідна дальність виявлення вертольота, яка може служити орієнтиром для винищувача знищеного гелікоптера. Вважається, що забезпечено виявлення вертолітної радіотехніки, що забезпечує роботу командного пункту. **Результати.** У статті проаналізована тенденція вдосконалення вертолітної техніки за останні роки. Відмічена зростаюча можливість використання вертольота, для вирішення завдань на полі бою, що ставить вертолітну техніку в один ряд разом із засобами нападу, з використанням літакової техніки. Зроблений висновок про те, що при боротьбі з вертольотами важливим питанням є розрахунок необхідного часу на прийняття рішення по їх застосуванню на командному пункті протиповітряної оборони. У статті, на прикладі роботи автоматизованої системи прийняття рішення на командному пункти аеродромів бригади тактичної авіації розглянута можливість використання запропонованої методики та проведені розрахунки виявлення дальності, що забезпечує прийняття рішення особою, яка приймає рішення, бригади тактичної авіації. Показано, що одним з ключових умов організації та успішного перехоплення вертольотів противника є обґрунтовані і своєчасні рішення по управлінню винищувачами на дистанційному управлінні тактичного рівня ВВС. Невизначеність і динамічність повітряного простору, часові обмеження, значний обсяг інформації і невизначеність, що характеризують дії вертольотів противника, які явно невизначені і суперечливі, що обумовлює зростання вимог до здійсненності та ефективності прийняття рішень на панелі управління ВПС. Одним з напрямків виконання таких вимог є автоматизація процесів управління винищувальної авіації на етапі бойових дій.

Ключові слова: радіолокаційний канал; командний пункт; радіолокаційна станція виявлення; маловисотна ціль; когерентність сигналів; винищувальна авіація; пункт управління.

Особенности локации вертолетов в приморских районах

А. Н. Артеменко, О. В. Струцинский, Е. В. Лукашук, О. В. Бесова

Аннотация. Цель статьи. Рассмотреть метод, с помощью которого рассчитывается требуемая дальность обнаружения вертолета, которая может служить ориентиром для истребителя уничтоженного вертолета. Считается, что обеспечено обнаружение вертолетной радиотехники, обеспечивающей работу командного пункта. **Результаты.** В статье проанализирована тенденция совершенствования вертолетной техники за последние годы. Отмечена возрастающая возможность использования вертолета для решения задач на поле боя, ставит вертолетную технику в один ряд вместе со средствами нападения с использованием самолетной техники. Сделан вывод о том, что при борьбе с вертолетами важным вопросом является расчет необходимого времени на принятие решения по их применению на командном пункте ПВО. В статье на примере работы автоматизированной системы принятия решения в командном пункты аэродромов бригады тактической авиации рассмотрена возможность использования предложенной методики. Проведены расчеты выявления дальности, обеспечивающей принятие решения лицом, принимающим решение, для бригады тактической авиации. Показано, что одним из ключевых условий организации и успешного перехвата вертолетов противника являются обоснованные и своевременные решения по управлению истребителями на дистанционном управлении тактического уровня ВВС. Неопределенность и динамичность воздушного пространства, временные ограничения, значительный объем информации и неопределенность, которые характеризуют действия вертолетов противника, которые явно неопределенны и противоречивы, что обусловливает рост требований к осуществимости и эффективности принятия решений на панели управления ВВС. Одним из направлений выполнения таких требований является автоматизация процессов управления истребительной авиацией на этапе боевых действий.

Ключевые слова: радиолокационный канал; командный пункт; радиолокационная станция обнаружения; маловысотная цель; когерентность сигналов; истребительная авиация; пункт управления.