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Drone: The key to the next era of war

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Abstract:

With the rapid development of the economic level, the weapons, equipment, and military combat capabilities of countries worldwide are gradually increasing, and unmanned combat systems will inevitably become the main development direction of future wars. This article takes the application of drones in the Russo-Ukrainian War as an example, aiming to analyze the changes brought about by using drones in modern warfare.

Keywords: Drones; Russia-Ukraine War Technological development; Role transformation; change.

1. Introduction

Drones are a military weapon that has only been applied in modern warfare in recent decades, and their increasing popularity has brought significant changes to modern warfare. The United States and Britain developed the first autonomous car during World War I. As a weapon, drones were successfully armed and deployed by the Nazi German military for the first time during World War II, used to carry bombs for aerial clearance. In the past 30 years, drones have been widely used in modern warfare, and their large-scale application has begun to play a leading role in all ongoing conflicts. This article takes the Russo-Ukrainian conflict as an example, aiming to answer a recent question: how do we understand the changes brought about by the application of drones in modern warfare?

2. Technological Breakthrough: Technological Development of Drones

2.1 Development history of drones

At the beginning of the 20th century, drones were initially successfully developed by Britain and the United States. These drones are mainly used for military surveillance and target aircraft missions. In the 1950s, with the advancement of wireless remote control technology, drones began to perform more complex tasks such as surveillance and intelligence gathering. In the 1960s and 1970s, drone technology was further developed, drone performance improved, and more drone models emerged. At the beginning of the 21st century, with the rapid development of computer technology, communication technology, and other fields, drone technology has been widely applied, not only in the military field but also expanded to the civilian field.

2.2 The working principle of military drones

The working principle of military drones mainly involves multiple aspects such as drone body design, navigation and control technology, sensor technology, communication technology, weapon and payload technology, and artificial intelligence and machine learning technology. The continuous development of these technologies has led to the continuous improvement of the performance of drones and the expansion of their application scope.

2.3 Advantages of Drones in War

Military drones are unmanned aircraft controlled and operated by remote control devices or self-contained programs. According to their control methods, they are mainly divided into three types: wireless remote control, automatic program control, and comprehensive control. Military drones have the characteristics of small size, lightweight, good maneuverability, and strong concealment. They can perform tasks in high-risk environments, greatly expanding their combat capabilities such as battlefield surveillance, target positioning, artillery calibration, firepower guidance, and evaluation[1].

3. Victory Weapon: The Sneak Attack of The Weak Force

On February 21, 2022, when the Russian army raided Ukraine's eastern provinces, and the VDV stroke to Antonov Airport. It was widely acknowledged that Ukraine might fail to maintain continuous resistance against the invasion by Russia. This is because there is a noticeable gap between Russia, ranking at the 2nd position, and its

counterpart, Ukraine, denoted as a Top 15 global military power in the 2023 military strength ranking by The Global Firepower. Seth Jones, senior vice president at the Center for Strategic and International Studies, suggested that the Ukrainian chain of command would quickly be paralyzed in the event of war. However, the resistance made by Ukraine for almost two years has not only surprised defense researchers but also has a startling impact on modern warfare. The determining factor in reversing the military tide was the application of drones.

Through the review of the application of drones in the early stage of the Russian-Ukraine war, it becomes clear that when the drone is effectively employed in asymmetric conflicts, it provides localized advantages for the weaker side. This hampers the other party's action, prolongs the conflict, and accomplishes the strategic aim of exhausting the stronger faction's resources. In such scenarios, drones have the potential to alter the course of the war and empower their user to perform better and exceed expectations. The application of military and modified civilian drones in the elite forces honed during the years of the Eastern Ukraine conflict played a decisive role in impacting the result of this war. Since the start of the war, Ukraine's military sent advanced military drones far into Russian territory, to strike naval vessels in the Black Sea, an airport located in Western Russia, and even key structures within Moscow. Ukraine soldiers applied the drones skillfully in reconnaissance and strike operations. Because the large and complex Russian army lacked related equipment in small units to respond to the drones, the Ukrainian army at the front gained considerable achievements from the tactic. In a battle that happened in a stretch of road northeast of Kyiv (E95) in March 2022, the 6th Regiment of the Russian 90th Tank Division lost a company's weaponry and equipment under an artillery strike assisted by drone surveillance. Many similar videos from the perspective of drones can be found on social media easily, demonstrating that a significant number of Ukrainian successes have come from the assistance of drones. Taking the Ukrainian military's TB-2 drone as an example, it has been showcased in various videos that this drone excels in battlefield surveillance, tracking, and tagging Russian military assets and, therefore, gained recognition as a Western "battlefield killer." Its accomplishments extend beyond conventional targets to include air defense systems and even naval vessels, marking significant advancements in drone warfare.

4. Arms Race: Empire Strikes Back

On the other hand, as one side gains advantages over the other party in drone application, the other side would also strengthen its drone capabilities to reduce the disparity, leading to a drone arms race. When this arms race reaches equilibrium, the conflict reverts to a competition of overall strength between the two sides. To the Russian military, the main challenge posed by the drone attack approach applied by Ukraine lies in the cost-effectiveness of intercepting them. Compared to the high cost of intercept, a modified civilian drone usually only costs a few thousand dollars. In comparison, a usual military model can only cost upward to a few hundred thousand dollars. For instance, a single "Shadow" drone costs $550,000, while an F-15 fighter jet is over $50 million. Surface-to-air missiles for drone interception cost over a million dollars.

Additionally, drone maintenance and training are more cost-effective; training a drone operator is considerably less expensive, around $2.6 million for an F-15 pilot. However, if no actions are taken to respond to the drones, the military will also bear a higher number of casualties. This diminishes the originally significant economic and military gap between the two sides, reducing its decisive impact on the outcome of the conflict. The Russian military, in response to the effective drone tactics employed by Ukraine, recognized the need to develop better drone tactics for battlefield use. As the conflict evolved into a prolonged standoff, front units were equipped with more modified civilian and portable military drones. At the beginning of the war, Russian conventional military drones, costing around $100,000 each, primarily used for surveillance and artillery guidance, offered poor performance compared to Ukrainian drones. To catch up in the drone race, the Kremlin reallocated more resources to low-cost explosive drones, which later proved wise. One example would be HESA Shahed 136, a cheap suicide drone armed extensively by the Russian military targeting armed extensively by the Russian military, which made the Ukrainian army exhausted from rushing and incurred significant casualties. The Russian military's pursuit and innovation in drone tactics brought both sides back to the starting line of the drone arms race. With the war losing its element of surprise, continuous NATO aid flowing into Ukraine, and a balance reached in the drone competition, the conflict returned to a tangle of attrition based on overall strength.

5. Technical barriers: the negative impact of countermeasures against technology

The countermeasures technology has brought many negative impacts to military drones, including increased mission risks, increased difficulty in execution, and legal and moral issues. Therefore, to develop and apply military drones, it is necessary to comprehensively consider

the challenges and response strategies of countermeasures technology to ensure the safety and effective use of drones[2].

5.1 Interference and destruction

For the navigation and control technology of drones, some countermeasures can interfere with the normal operation of drones or even cause them to lose control by transmitting interference signals or implementing electromagnetic attacks. This may result in drones being unable to complete tasks or accidentally entering restricted areas.

5.2 Identification and tracking

Anti-countermeasures technology can monitor and track drones in real time. The type, quantity, and intent of drones can be identified by analyzing communication signals, flight trajectories, and other data of drones. This puts drones at risk of being detected and tracked during missions.

5.3 Defense and Counterattack

For the aggressive use of drones, countermeasures technology can deploy defense systems, such as anti-aircraft missiles, anti-aircraft guns, etc., to strike or force drones to change course. This increases the difficulty and risk of drone missions.

6. New Battlefield: Future Development and Application of Drones in Warfare

The outstanding performance of drones in the Russia-Ukraine war has shown countries around the world the important role of drones in the war. The future development of military drone technology will become a new round of competition[3].

6.1 Diversified tactical application

With the continuous advancement of drone technology, its tactical applications in warfare will become more diverse. Drones can perform more complex tasks, including surveillance, attack, electronic warfare, etc. In the future, drones will pay more attention to collaborative operations, and multiple drones will achieve collaborative operations such as information sharing and task allocation to improve combat efficiency and effectiveness.

6.2 Intelligence and Autonomy

With the continuous development of artificial intelligence and machine learning technology, the level of intelligence and autonomy of drones in warfare will continue to improve. Drones can autonomously complete tasks such as target recognition, threat assessment, and attack decision-making, reducing reliance on humans and improving operational efficiency and security. This will enable drones to play a greater role in warfare.

6.3 The development of stealth and anti-stealth technologies

With the widespread application of drones in warfare, stealth and anti-stealth technologies will become important directions for future development. Drones will use more advanced stealth materials and technologies to reduce the risk of being detected and attacked. At the same time, anti-stealing technology will be developed to enhance unmanned aerial vehicles' surveillance and strike capabilities [4].

6.4 Networking and informatization

In the future, drones will pay more attention to networking and information construction, achieving information sharing and collaborative operations with ground command systems, other branches of the military, and allied forces. This will enable drones to better integrate into the joint combat system and improve operational efficiency and collaborative capabilities.

7. Conclusion

Drones play an important role in modern warfare, and their increasing popularity has brought significant changes to warfare. In the Russo-Ukrainian War, the Ukrainian military effectively attacked the Russian military using drones, gaining local advantages and allowing the weaker side to perform better than expected. This indicates that drones may alter the course of war, allowing users to perform better and exceed expectations. In addition, drones also have surveillance and strike capabilities, which can effectively hinder the other party's actions, prolong conflicts, and achieve strategic goals of depleting powerful faction resources. However, although the application of drones is becoming increasingly important, countermeasures are also constantly upgrading, and a new era of truly unmanned warfare has not yet arrived. Therefore, although drones are important weapons in modern warfare, they must be combined with other military means to achieve victory. The trend of future wars will become more complex, and the application of drones will be more widespread. However, comprehensive strength and human resources will still be important factors in determining the outcome of wars.

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