Analysis of the Application of Typical Combat Scenarios Utilizing Russian Ground Unmanned Equipment

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Abstract: With the continuous development of related technologies, unmanned combat methods are gradually being valued by countries around the world. The prospects of ground unmanned equipment are extremely broad, and it is expected to achieve significant strategic breakthroughs and practical applications. Russia has always attached great importance to research related to unmanned combat. Through years of technological research and equipment development, Russia has made significant progress in unmanned combat and has widely used ground unmanned equipment in recent local conflicts. This paper systematically analyzes the typical application of Russian ground unmanned equipment in the Syrian battlefield and the Russia-Ukraine conflict by means of literature retrieval, systematic research and example demonstration. It focuses on the operational process, prominent advantages and existing shortcomings of Russian ground unmanned equipment to study the effectiveness of unmanned combat equipment in practical application. Through case studies and practical application of unmanned combat equipment, it provides a reference basis for the future development of unmanned equipment and research on unmanned combat in our army.

Keywords: Russian Military; Ground Unmanned Equipment; Battlefield Application; Application Analysis

1. Introduction

Since the turn of the century, unmanned combat platforms have fundamentally reshaped the landscape of modern warfare. From the Nagorno-Karabakh conflict to the Russia-Ukraine clash, unmanned combat equipment has emerged as a crucial frontier in the realm of military technological advancements [1]. Skies are dominated by drones, seas patrolled by unmanned vessels, and land traversed by unmanned vehicles, showcasing the thriving development of integrated unmanned combat systems. As nations increasingly explore military unmanned systems technology solutions, tangible successes in real combat scenarios have been achieved. In the theater of war, unmanned platforms not only symbolize a competition of comprehensive national strength but also represent a battle among weapon systems. As a significant military power, Russia is actively driving forward the research and application of unmanned equipment. The country has developed a series of high-performance unmanned ground vehicles and robotic technologies, which have found wide applications in conflicts against sophisticated weaponry, infusing new vitality and momentum into national security and military capabilities.

2. Analysis of the Deployment of Russian Ground Unmanned Equipment in the Syrian Battlefield

2.1 Combat Application

In the Syrian battlefield, Russian ground unmanned equipment has played a significant role in the military operations. One of the most notable instances is the Battle of 754.5 Heights. Situated in the western Latakia of Syria, 754.5 Heights commands several key routes leading to the Aleppo. In a bid to reclaim the entire Latakia, the Syrian government forces launched an offensive in December 2015.

Nevertheless, due to a lack of preparation and battlefield reconnaissance, the initial offensive of the Syrian government forces in the Battle of 754.5 Heights ended in failure, prompting

them to seek assistance from Russia. In response, the Russian military deployed a platoon of robotic combat units, predominantly featuring unmanned combat platforms, employing a novel mixed formation combat mode integrating both human and unmanned elements. This platoon was structured around the "Cassiopeia-D" automated command system, aerial drone "Swarm", and ground unmanned combat vehicles "Wolfpack", establishing an intelligent combat system. In a remarkably swift maneuver, the Russian forces managed to defeat 77 enemy combatants and successfully seize control of the heights in just over 20 minutes.

In this decisive battle, the Russian military employed the "Cassiopeia-D" automated command system as the central command core. Utilizing the "Swarm" drones for battlefield intelligence gathering, they effectively monitored the battlefield dynamics and orchestrated ground forces comprised of six "Platform-M" tracked combat robots and four "Algo" wheeled combat robots. As they approached within approximately 100 meters of the main stronghold of the Islamic State militants, the combat robots initiated an assault, utilizing their onboard machine guns and anti-tank missiles to draw enemy fire. The militants found it challenging to accurately target these robots, inadvertently revealing their own positions. Leveraging real-time intelligence transmitted by the aerial "Swarm" and ground "Wolfpack", the Russian forces swiftly directed long-range fire support units. The "Acacia" self-propelled artillery group precisely targeted the exposed enemy positions with artillery fire.

This fusion-based combat system, combining manned and unmanned elements with seamless coordination, not only reduces the need for human personnel in combat and minimizes casualties but also addresses the limitations of unmanned aerial vehicles with smaller payloads. It is poised to become a crucial avenue for future combat operations.

2.2 Prominent Advantages

The Battle of 754.5 Heights showcased notable advantages as the Russian military, in coordination with unmanned assets, achieved swift reconnaissance, precise strikes, and shared intelligence, resulting in a significant battlefield triumph. Seeking victory, the Syrian government forces adopted the traditional "three-pronged attack" approach, involving intelligence gathering, firepower readiness, and armored assault. However, due to both sides operating on similar operational dimensions and the complex and steep terrain of 754.5 Heights, breaking through proved challenging for the military. In stark contrast, the Russian forces established a tactical method known as "Swarm reconnaissance, Wolfpack assault, human-machine coordination, and methodical strategy" [2]. Through the integration of manned and unmanned elements, the Russian military efficiently amalgamated its combat forces, elevating from a personnel-centric system to a human-machine hybrid system, successfully seizing the victory through a combination of comprehensive reconnaissance and saturated attacks. "Decisiveness lies in the loop of decision-making". At the heart of Russian command was the "Cassiopeia-D" automated command system, consolidating reconnaissance intelligence, command control, data analysis, and firepower guidance into a cohesive unit. Following the setback of the Syrian forces' offensive and their request for support, the Russian military first utilized this system to grasp the battlefield dynamics obtained by the aerial "Swarm", then employed aiding decision software to select the optimal path for ground "Wolfpack" assault. Subsequently, they analyzed the identified enemy firepower threats and directed the rear self-propelled artillery group to carry out precise strikes, ultimately commanding manned forces to capture the heights.

With advancements in multimodal human-machine interaction technology and automatic semantic processing, human-machine interaction information holds the promise of achieving "barrier-free transmission", better realizing the "decisiveness lies in the loop" paradigm. Advanced automated command systems can integrate experience, battlefield conditions, and other pertinent information to assist commanders in accurately understanding the battlefield situation, forecasting in advance, and selecting optimal solutions based on the commanders' needs [3].

2.3 Limitations

The formidable firepower capabilities of the "Uranus-9" unmanned vehicle prove effective only when operators can genuinely detect and accurately engage enemy forces, an aspect that revealed persistent issues during testing on the Syrian battlefield. The thermal and electro-optical sensors of the "Uranus-9" unmanned vehicle failed to detect enemies beyond 2km, falling significantly short of the military's claimed 6km benchmark. Moreover, instability plagues the system as both sensors and guided weapons of the "Uranus-9" unmanned vehicle prove ineffective during maneuvers. Notably, during six instances, severe delays occurred when issuing firing commands, with one command failing to execute altogether.

Furthermore, the suspension of the "Uranus-9" tracked unmanned vehicle frequently encounters disruptions from unreliable idler wheels and suspension springs, necessitating frequent maintenance and imposing significant constraints on the vehicle's operational duration. The most significant issue lies in the discrepancy between the official remote control distance of 2.9km for the "Uranus-9" unmanned vehicle in urban environments and the actual effective control range of only 300-400m. Within such a short span, controlled vehicles are prone to enemy firepower exposure, with their control signals easily disrupted by hills, structures, and other terrain features [4]. In the Syrian battleground, these factors led to the "Uranus-9" unmanned vehicle experiencing 17 instances of one-minute-long remote control failures and two instances of 1.5-hour-long loss of contact.

3. Analysis of Russian Ground Unmanned Equipment in the Russia-Ukraine Conflict

In the Russia-Ukraine conflict, unmanned warfare has primarily evolved into a novel mode featuring a combination of unmanned aerial vehicles and unmanned ground vehicles. While Russia's first unmanned combat vehicle, the "Uranus-6", has seen action in the conflict, its role has been confined to mine clearance, failing to display its full potential in terms of firepower[5]. Russian large-scale military drones are utilized for aerial reconnaissance and ground target strikes; although small commercial drones have limited airtime, they offer tactical advantages in certain scenarios, enabling tasks such as surveillance and search and rescue operations. The Russian military extensively employs low-altitude ground drones to support ground combat operations on the frontlines, significantly enhancing the army's operational capabilities. The Russia-Ukraine conflict has also served as a stage for the remarkable performance of low-altitude drones, showcasing their prowess in the battlefield.

3.1 Combat Applications

According to reports from the Russian newspaper, in the Russia-Ukraine conflict, the Russian army extensively utilizes drones for reconnaissance, strikes, and target correction missions. Particularly in Ochakiv, Mykolaiv oblast, Russian forces employed the "Geranium-2" drone for intensive strikes against Ukrainian armed forces targets. Previously, the "Geranium-2" successfully attacked the Ukrainian Southern Command headquarters located in the port of Odessa.

Recently, the 66th Artillery Battalion of the Ukrainian 406th Brigade also became a target of the "Geranium-2" drone. Simultaneously, the "Geranium-2" drone targeted a Ukrainian technical support detachment that had recently returned from the UK. In this operation, the "Lancet-3" drone also participated, destroying the Ukrainian anti-aircraft command post, guard unit, and fuel depot. Approximately 20 "Geranium-2" and "Lancet-3" drones were reported to have been involved in this operation, with both drones complementing each other in their mission execution. The Russian military's dense use of kamikaze drones on the battlefield for the first time has sparked concerns among Ukrainian military leadership.

The Russian "Lancet" cruise missile, also known as the "Kamikaze Squad" drone, has become a nightmare for the Ukrainian armed forces [6]. In combat, Russia primarily targets vehicles, artillery, and air defense systems provided by the United States and European countries. Upon identifying an enemy target, operators launch the drones into the air, after which the "Lancet" cruises to the designated area until the target is spotted. The electro-optical guidance system on the drone's nose captures images of ground targets, transmitting them to the operator's console. Through onboard artificial intelligence or operator guidance, the enemy can be locked

onto, allowing for disengagement of safety and detonation upon reaching the ground under the operator's control.

3.2 Prominent Advantages

In the ongoing Russia-Ukraine conflict, the Russian military has introduced an upgraded variant of the "Lancet-3" drone. With a heightened combat payload weight of 5 kilograms, this drone showcases advancements in aerial capabilities. Both the "Lancet-1" and "Lancet-3" models rely on ground launch systems for takeoff, achieving speeds ranging from 80 to 110 kilometers per hour and exhibiting flight endurance of 30 to 60 minutes, tailored to meet the demands of individual combat operations.

One of the most striking features of the "Lancet" drone lies in its capacity to autonomously establish navigation fields, distinguishing it from comparable weapons systems. This autonomous capability has earned it a reputation as a precision instrument of warfare, akin to performing surgical strikes with pinpoint accuracy.

Unlike conventional UAV designs, the "Lancet" sports a unique configuration, resembling a missile with four X-shaped wings distributed at its front and rear. Propulsion is managed through a compact electric motor positioned at the tail section, leveraging twin propellers for thrust. The lightweight nature of the electric motor coupled with its minimal noise emissions renders the drone elusive to enemy detection. Furthermore, to enhance its agility in flight, the "Lancet" is equipped with a streamlined launching mechanism, utilizing a small catapult system and rail guidance for efficient takeoff and navigation towards designated target zones.

Equipped with interchangeable warhead modules, the "Lancet" drone boasts enhanced versatility in engaging diverse targets with precision. By adapting warhead types to match specific objectives, such as employing armor-penetrating shaped charges against armored vehicles or thermobaric warheads for strategic targets like command centers, the drone showcases adaptability in its offensive capabilities. Additionally, the drone features a sophisticated pre-contact detonation functionality, enabling remote operators to direct the drone above target areas for timely deployment of high-explosive charges. This tactical approach maximizes the reach of munitions' fragmentation and shockwave effects, complicating evasion efforts for adversaries on the battlefield [7].

3.3 Existing Drawbacks

Amid the conflicts between Ukraine and Russia, the "Lancet" drone has exhibited formidable combat capabilities but also manifests four primary drawbacks. Primarily, its system integration design falls short as the wings lack foldability, necessitating on-site assembly, posing operational inconveniences. Furthermore, the lengthy and cumbersome launch guidance rails are ill-suited for field mobility. Secondly, the overall performance and reliability are compromised. Driven by Russia's emphasis on cost efficiency, concessions have been made in the drone's system performance and pricing [8]. With limited range and modest warhead weight, the drone's battlefield prowess has been partly promoted by the Russian military to counter the threats posed by Ukraine's advanced weaponry. Moreover, Russia's domestic industrial framework displays vulnerabilities, with numerous components reliant on Western imports. This dependency raises concerns regarding potential production challenges on a large scale. Despite the Russian military's contemplation of mass equipping the drone, the predicament of component imports poses a significant obstacle to Russia's envisioned mass production of the "Lancet" drone. Lastly, various unfavorable factors hinder its practical development. Positioned as a novel weapon system, the "Lancet" drone remains in a phase where design experience accumulation and operational methodology improvements are essential, inevitably resulting in inadequacies. Overcoming these challenges in the future could potentially elevate the combat effectiveness of the "Lancet" drone significantly [9].

4. Conclusions

Russian ground unmanned equipment stands as a vital component of active gear, showcasing a strategic edge in the construction of ground weaponry and serving as a standout asset within the Russian Army's arsenal. The development status of Russian ground unmanned equipment not only directly influences the construction level of the

Russian Army but also shapes the future trajectory of land-based equipment development. Hence, it is imperative to place emphasis on Russian ground unmanned equipment in researching the next phase of ground battlefield equipment development, laying a robust foundation for ground equipment construction.

Through years of development and accumulation of experience, Russian ground unmanned equipment has established a mature development model, facilitating the rapid advancement of Russian ground unmanned equipment and contributing to the combat readiness of their military forces. Furthermore, the Russian military has demonstrated certain effectiveness in the operational aspects of ground unmanned equipment systems, conducting experiments in the Syrian battlefield. Studying the Russian military's practices in the development of ground unmanned equipment holds significant importance for learning from and emulating their development experiences, expediting our military's progress in ground unmanned equipment development.

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