

Research on Unmanned Ground Platform with Small UAVs of Foreign Forces

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Abstract: Confronted with the escalating intricacy of the international arena and the unceasing military standoffs in certain locales, the harshness of the battlefield milieu significantly jeopardizes the safety of the troops. As unmanned technology evolves, terrestrial unmanned combat platforms are poised to ascend the historical stage, leveraging their numerous advantages and supplanting combatants in undertaking reconnaissance, surveillance, explosive ordnance disposal, artillery strikes, and data dissemination within hostile environments. Nevertheless, these autonomous ground systems grapple with issues such as suboptimal environmental perception and constrained firepower. This treatise critiques the limitations inherent in conventional ground-based manned combat platforms during hostilities, investigates the integration of small Unmanned Aerial Vehicles (UAVs) operating at low altitudes with ground unmanned combat platforms, and expounds upon their superiority in urban offensive operations.

1. Introduction

The autonomous combat system is an integrated entity comprising an unmanned combat platform, mission payloads, a command and control apparatus, and an aero-terrestrial information network. It represents a pivotal asset in achieving information dominance, executing precise strikes, and fulfilling specialized combat objectives within the digital battlespace. The unmanned combat platform constitutes the linchpin of this system, characterized by its self-propelled yet unmanned nature, capable of both autonomous and remote operation, and designed for either reusability or single-use deployment. These platforms can bear both lethal and non-lethal payloads [1]. They facilitate support to combat personnel or independently engage in operations, undertaking military duties such as reconnaissance, logistics, transportation, and fire support. Primarily tasked with monotonous, tedious, and unsanitary duties, they remain impervious to the adverse emotional states that human soldiers may experience. Furthermore, they can supplant human soldiers in the execution of perilous military tasks under diverse extreme conditions, thereby preserving the lives of servicemen in the crucible of war. The land-based unmanned combat platform, in particular, boasts superior concealment, agile maneuverability, and robust adaptability to the theater of war, potentially tilting the balance against conventional armaments and thus, garnering significant regard from the militaries of various nations.

2. Characteristics of Unmanned Ground Platform

The terrestrial unmanned combat platform integrates environmental perception, decision-making planning, and motion control technologies. It can perform reconnaissance, surveillance, explosive ordnance disposal, provide fire support, communication relay, and medical assistance on the battlefield, thereby mitigating potential threats to soldiers' lives during combat engagements. The platform is characterized by the following attributes:

Enhanced Intellectual Prowess: With the widespread adoption of autonomous controls and artificial intelligence methodologies, coupled with advancements in mechanical systems, sensors, processors, and control architectures, the unmanned platform possesses a degree of intelligent

command, decision-making, and autonomous action capabilities. Upon receiving directives from commanders through the command apparatus, it can respond expeditiously, exhibiting an intelligence edge in information acquisition and processing that surpasses human capabilities.

All-Weather Operational Versatility: The ground unmanned combat platform can supplant combatants in performing duties under severe conditions such as blast waves, radiation, biochemical contamination, and extreme natural environments, remaining unaffected by fatigue.

Robust Survivability: As the design eliminates the need for human accommodation, the unmanned combat platform, compared to manned systems, boasts advantages such as compactness, refined engineering, sturdy construction, enhanced mobility and passability, superior stealth, extended latency, and elusiveness to adversary detection.

Diverse Mission Capabilities: The unmanned ground combat platform can accommodate various mission payloads (e.g., armaments, observational detection systems, robotic appendages, etc.) and expand its application scope to fulfill diverse operational exigencies.

3. Problems in Operational Application of Unmanned Ground Platforms in Foreign Military

In comparison to aerial or naval unmanned combat platforms, terrestrial unmanned combat platforms encounter more intricate and unpredictable obstacles. To navigate and execute tasks in alien and complex terrains, a ground-based unmanned combat platform must possess the advanced capability to sense environmental information at long, medium, and close ranges. Leveraging this acquired intelligence, it can accurately assess the surroundings and identify potential threats. It is crucial to distinctly demarcate areas that are traversable, inaccessible, or vulnerable to attack. If a ground unmanned combat platform operates independently, without external support, it can achieve short-range information perception (on the order of 100 meters) and facilitate certain tactical maneuvers, yet it falls short in medium to long-range perception. Moreover, close-range perception is often impaired by obstructions, and the operational range of enemy weaponry exceeds our perceptive capabilities. Modern warfare has transcended distance limitations; regardless of the separation between forces, the threat of attack persists. To realize panoramic and multi-distance information awareness enhances our survivability and mission effectiveness, which is an exigent requisite for joint operations and network-centric warfare.

Weapon Load Constraint: Although the ground unmanned combat platform can be outfitted with diverse weapon modules tailored to specific mission directives, its primary function in ground engagements and neutralizing terrestrial targets dictates that it is principally armed with surface attack weapons within the confines of its payload capacity. Anti-aircraft defense is limited to a handful of lightweight missiles and electromagnetic armaments to counteract aerial adversaries, resulting in limited adaptability and suboptimal efficacy. In complex terrain engagements, such as urban warfare, obstacles like high-rises and alleyways inhibit the deployment of unmanned platform weaponry. This highlights operational challenges encountered by foreign militaries in the application of unmanned ground platforms.

4. Ground Unmanned Combat Platform With Low-Altitude Small UAVs of Foreign Army

The foreign military's ground-based unmanned combat platform, equipped with low-altitude micro UAVs (operational altitudes ranging from 1000-7000m for medium altitude, 100-1000m for low altitude, and below 100m for ultra-low altitude), is a traditional unmanned combat platform that controls a low-altitude, small-sized unmanned aerial vehicle. This platform exhibits the following characteristics:

The unmanned ground combat platform is outfitted with 2-3 micro UAVs, depending on its payload capacity, enabling it to form an aerial-ground cooperative tactical squad. This configuration endows it with a significant degree of aerial-ground cooperative combat prowess, as well as three-dimensional reconnaissance, surveillance, and strike capabilities.

The micro UAVs are capable of vertical takeoff and landing on the ground-based unmanned platform, thereby mitigating the platform's requirements for the UAVs. These micro UAVs are fully

controlled by the ground-based unmanned combat platforms and operate autonomously in coordination. They possess the capability to launch attacks with small arms and electromagnetic weapons. Light armaments are employed against unarmored targets, such as personnel and utility vehicles, while electromagnetic weapons are used to discretely engage intelligent unmanned targets, including UAVs and ground-based unmanned combat platforms. The weaponry can be varied according to the specific mission.

The ground-based unmanned combat platform can replenish energy and ammunition for the micro UAVs, enhancing their sustained reconnaissance, surveillance, and combat capabilities. The micro UAVs boast robust battlefield reconnaissance, surveillance, and environmental perception abilities, sharing information with the ground-based unmanned combat platforms, which significantly compensates for the latter's limitations in environmental perception.

5. Ground Unmanned Combat Platform With Low-Altitude Small Unmanned Aerial Vehicle of Foreign Army

5.1. Characteristics of Urban Offensive Operations

Urban warfare constitutes a primary modality of contemporary military engagements. The urban landscape, characterized by its intricate network of streets and alleys, is punctuated by towering, robust, and contiguous structures, underpinned by the intricacy of subterranean engineering infrastructure, all contributing to suboptimal operational conditions. Such environments impart distinct attributes onto combat dynamics, setting them apart from traditional militarized confrontations.

5.1.1. Abnormal and Complex Battlefield Environment

Urban warfare, the defensive side can build strong forts by using the high number of buildings and underground engineering facilities extending in all directions. A large number of mines and barriers can be placed in urban areas; can be condescending, to point control the surface, observation and sniping; We can use buildings, blocks, and organize crossfire. For the attacking side, it is often necessary to attack and seize key points, Street fighting with short soldiers, coupled with the terrain, the enemy is not clear, easy to be ambushed and sniper fire, suffered a large number of casualties.

5.1.2. Difficulty in Communication and Command Coordination

In urban combat, the defensive party can construct robust fortifications by leveraging the abundance of edifices and subterranean engineering infrastructure that proliferate in all directions. The urban terrain can be adeptly utilized to deploy an extensive array of mines and barriers; to exert dominance over key points, enabling surface control, surveillance, and sniping; and to orchestrate intersecting fields of fire utilizing buildings and blocks. As for the attacking force, it frequently finds itself compelled to assault and capture strategic positions. Engaging in close-quarters combat with short-range troops, compounded by the unfamiliar terrain and the elusive nature of the enemy, often results in ambushes and sniper fire, leading to substantial casualties.

5.1.3. Limited Use of Equipment Superiority

The current military apparatus is predominantly engineered for conventional terrain engagements. Tactics optimized for such terrains are significantly compromised in urban combat scenarios. Urban warfare entails negotiating unconventional topography and intricate tactical milieus. The efficacy of battlefield surveillance, precision positioning systems, aerial bombardment, and distant artillery deployment is substantially hindered in the secluded, disguised, and clandestine domains of urban landscapes.

5.1.4. Difficulty in Shooting and Maneuvering

The extant military apparatus is principally engineered for conventional terrain confrontations. Tactics tailored for such terrains are significantly curtailed in urban combat scenarios. Urban

warfare mandates negotiating unconventional topography and intricate tactical milieus. The efficacy of battlefield surveillance, precise positioning systems, aerial bombardment, and distant artillery deployment is substantially hindered in the secluded, disguised, and clandestine domains of urban landscapes.

5.2. Urban Offensive Operational Application of Ground Unmanned Platform with Low Altitude Small UAVs

Urban combat scenarios often culminate in a stalemate, with belligerent forces engaging in a tug-of-war that precipitates a substantial toll in casualties. This characteristic was notably epitomized in the Battle of Stalingrad during World War II, and more recently, in the conflicts at Mosul and Aleppo. The utilization of ground-based unmanned combat platforms, complemented by low-altitude micro UAVs, can mitigate direct personnel involvement within urban theaters, consequently diminishing the number of casualties.

5.2.1. Unmanned Equipment Reduces Casualties

In urban combat, the defensive faction can construct robust fortifications by leveraging the abundant structures and expansive subterranean engineering networks. The metropolitan terrain can be rigged with extensive minefields and barricades; such measures facilitate overbearing control of surface positions, surveillance, and sharpshooting. Tactical deployment of buildings and blocks enables the organization of interlocking fire. On the offensive, forces frequently face the imperative to assault and capture strategic locations. Engaging in close-quarters combat with compact units, combined with unfamiliar terrain, leaves troops susceptible to ambushes and sniper fire, often resulting in substantial casualties.

5.2.2. Strong Reconnaissance Perception

The terrestrial unmanned combat platform, equipped with low-altitude micro UAVs, possesses the capacity for both ground and aerial reconnaissance perception. In urban environments, when confronted with unfamiliar terrain and targets, 2-3 low-altitude micro UAVs can conduct reconnaissance on numerous unknown territories and targets, ensuring an all-encompassing environmental awareness.

5.2.3. Flexible Firepower Advantage

The terrestrial unmanned combat platform, integrated with low-altitude micro UAVs, leverages the synergy of ground and aerial ordnance, culminating in an air-ground firepower synergy. Micro UAVs operating at low altitudes are equipped with lightweight armaments capable of inflicting damage on personnel and general-purpose vehicles, while the ground platforms can be armed with weapons contingent upon the varied objectives at hand, endowing them with anti-armor and anti-aircraft functionalities. Low-altitude micro UAVs possess the capability to scour and pursue targets within intricate terrains, such as edifices and alleyways, and inflict damage upon them.

5.2.4. Flexible Operational Application

When a singular terrestrial unmanned combat platform, equipped with a low-altitude compact UAV, undertakes a combat operation, the ground platform can function as the primary base to execute a battlefield assault mission, while the low-altitude compact UAV offers an extensive battlefield situational awareness and protective fire for the UAV; Alternatively, the low-altitude, diminutive unmanned aircraft can be primarily deployed to execute versatile aerial reconnaissance and strike missions, with the terrestrial unmanned platform furnishing it with the necessary energy and munitions for sustained combat, as well as covering fire from the ground. When a certain quantity of terrestrial unmanned combat platforms, carrying low-altitude small UAVs, execute combat tasks, they can form effective formations, with low-altitude small UAVs forming drone swarms, and terrestrial unmanned combat platforms forming combat formations to jointly assault targets.

6. Conclusion

The integration of a low-altitude small UAV with an unmanned ground platform significantly augments the latter's situational awareness and offensive capabilities, thus conferring considerable utility to such platforms.

References

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