

PROTECTION OF DRONES FROM ELECTRONIC WARFARE

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In recent years, unmanned aerial vehicles (UAVs) have become one of the most important technological tools in modern military operations. Initially, drones were mainly used for civilian purposes such as aerial photography, monitoring of public events, and sports competitions. However, with the rapid development of modern technologies, their application has expanded significantly, particularly in the military sphere.

The ongoing Russia–Ukraine war clearly demonstrates the increasing role of drones in modern combat operations. UAVs are widely used for aerial reconnaissance, artillery fire correction, surveillance, and precision strikes against armored vehicles and personnel. Due to their relatively low cost, high maneuverability, and minimal risk to operators, drones have become an essential element of modern warfare.

The growing effectiveness of UAVs has led to the development of various countermeasures designed to neutralize them. One of the most effective approaches is the use of electronic warfare (EW) systems that disrupt the control and navigation of drones.

The Impact of Electronic Warfare on Drones

Electronic warfare systems affect drones by interfering with radio signals used for communication, control, and navigation. This interference may include signal jamming, signal interception, or manipulation of satellite navigation signals.

The primary objective of EW systems is to disrupt the connection between the drone and its operator. When this communication link is interrupted, the drone may lose control, deviate from its route, or perform an emergency landing.

One of the most common EW techniques is GPS jamming, which blocks satellite navigation signals. As a result, the drone cannot determine its position accurately. Another widely used method is GPS spoofing, where false navigation signals are transmitted to mislead the drone about its actual location. In such cases, the drone may automatically land or change its course based on incorrect coordinates.

Methods of Protecting Drones from Electronic Warfare

To counteract the effects of electronic warfare, modern UAVs incorporate several protective technologies. One important method is the use of encrypted communication channels. Advanced cryptographic algorithms protect control signals from interception or manipulation.

Another widely used method is frequency hopping. In this technique, the communication frequency between the drone and the operator changes rapidly within a wide frequency spectrum. This makes it significantly more difficult for electronic warfare systems to jam the signal effectively.

Autonomous navigation is another important protection method. In this mode, the drone follows a pre-programmed flight route stored in its onboard computer without relying on GPS signals.

This approach allows the drone to continue its mission even in environments with strong electronic interference.

Additionally, modern drones may use special anti-jamming devices. These systems utilize technologies such as Controlled Reception Pattern Antennas (CRPA) to filter out interference and focus on legitimate satellite signals.

As a result, navigation accuracy and operational stability are significantly improved.

FPV Drones and Their Operational Characteristics

First Person View (FPV) drones represent a special category of UAVs widely used in modern combat operations. In FPV systems, the operator receives real-time video from the drone's onboard camera through specialized goggles or screens. This allows the operator to control the drone as if viewing the environment from the drone's perspective.

FPV drones typically consist of a camera, transmitter, receiver, flight controller, and electric motors.

Video signals are commonly transmitted using the 5.8 GHz frequency band. In environments with heavy electronic interference, additional transmitters operating at 1.3 GHz may be used to improve signal stability.

Due to their small size, high maneuverability, and relatively low cost, FPV drones are particularly effective in reconnaissance missions and precision strike operations.

Unmanned aerial vehicles have become an indispensable component of modern military operations. However, their effectiveness is significantly influenced by electronic warfare systems designed to disrupt communication and navigation signals.

Although it is currently impossible to completely eliminate the effects of electronic warfare, modern technological solutions significantly increase drone survivability.

Encryption technologies, frequency hopping communication, autonomous navigation systems, and anti-jamming devices play a crucial role in protecting drones from electronic interference.

The continuous development of counter-electronic warfare technologies will further enhance the operational effectiveness and reliability of UAV systems in future military conflicts.

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