Preliminary Study on Intrusion Prevention System of Small Aircraft Applied to Large Hydropower Station

Rongzhang Guan\textsuperscript{1,}\textsuperscript{a}, Shuang Wang\textsuperscript{1,}\textsuperscript{b}, Sanyao Xiong\textsuperscript{1,}\textsuperscript{c} Xiaoqian Nie\textsuperscript{2,}\textsuperscript{*}

\textsuperscript{1}Xiluodu Hydropower Station, Yunnan, China
\textsuperscript{2}Shanghai Radio Equipment Research Institute, Shanghai, China

\textsuperscript{*}Corresponding author e-mail: xqnie93@163.com, \textsuperscript{a2}27340430@qq.com, \textsuperscript{b}673089692@qq.com, \textsuperscript{c3}328859284@qq.com

Abstract. The operation of hydropower stations plays a very important role in improving the quality of power supply, reducing the cost of electricity, reducing environmental damage, protecting the ecological environment, and achieving sustainable economic development. The low-altitude aircraft defense system using for hydropower station is mainly for the control and control of low-altitude drones that enter important areas of the hydropower station. Low-altitude drones entering important areas of hydropower stations are closely monitored, tracked throughout, and electromagnetic strikes are automatically guided to achieve drone drove and forced landing.

1. Introduction

In recent years, with the gradual opening of the country's low-altitude airspace and the country's active support of the development of the general aviation and drone industry, the traditional physical protection mainly targets ground threats, causing the threat and intrusion of hydropower stations from aerial targets. Some important hydropower facilities in China have been repeatedly attacked and threatened by low-altitude small aircrafts such as aero-planes, paragliders, hot air balloons, and drones. Requested relevant groups to formulate management procedures for low-altitude small aircraft prevention and control, formulate corresponding emergency plans, and strengthen the monitoring and prevention and control of low-altitude small aircraft. It is necessary for major hydropower stations to establish low-altitude aircraft detection and interference systems, and to monitor and counteract low-altitude aircraft by adopting comprehensive management and control measures [1-2].

Through infrastructure construction, important parts within the coverage of a hydropower station can be built, advanced technology, reasonable layout, complete functions, reliable and efficient UAV integrated management and control network, providing dynamic, accurate and comprehensive spectrum monitoring functions, with a full range of UAVs Comprehensive management and control capabilities, realizing regional UAV early warning, regional protection, regional UAV track estimation, and comprehensive display of regional electromagnetic situation[3-4].
2. Composition of low-altitude aircraft defense system

The low-altitude aircraft defense system of a hydropower station is mainly composed of a command and control center, a monitoring station for key parts, and a hand-held interference device.

The monitoring station is mainly composed of passive detection equipment, active detection equipment, photoelectric monitoring equipment, and interference suppression equipment. Its main function is to complete the search, tracking, identification and countermeasure of targets invading key areas of hydropower stations. The main functions of each component unit are as follows: Active detection equipment can actively sense the moving target information in the perimeter defense zone around the clock, all day, and realize the search, tracking and classification of intruding targets, and automatically alert in real time; passive detection equipment passes the measurement Characteristic parameters of radio waves such as digital transmission and image transmission of drones, to obtain the direction of radio wave propagation, to search for, track and classify intruding targets, and to provide real-time automatic alarms; photoelectric monitoring equipment guides active and passive detection information Tracking and identification of intruding drones; interference suppression equipment cuts off communications between drones and remote controls, and between drones and navigation satellites by transmitting directional high-power interference radio frequencies to intruding drones. Forcing the drone to land or return directly[5].

The command and control center is mainly composed of a database server, an application processing server, a monitoring workstation, system software, and network equipment. Its main function is to fuse and process the data detected by the front-end detection equipment of the monitoring station, and form a comprehensive situation through data fusion. Monitor all kinds of activity targets in the area, and monitor and display in the command and control center to provide global information for control personnel.

3. Working principle of low-altitude aircraft defense system

Active detection equipment and passive detection equipment search and detect the set airspace. When one or more drones enter the early warning airspace of the hydropower station, the system can detect the position, distance, speed, altitude, and signal characteristics of the invading drone. And other information to collect, and draw real-time tracks on the map, and track numbers. The command and control center uses technologies such as active and passive information fusion, multi-station information fusion, and comprehensive situational awareness to eliminate false and interference targets, determine the nature and threat level of the intruding drone, and then automatically alert and control the photoelectric monitoring to be suspicious. The airspace where the target is located will automatically track and monitor the invading drone target and take photos to obtain evidence. For the drone entering the key protection area, if the monitoring personnel judges that the drone has invaded the drone, at this time, the target will be dealt with by coordinated interference to achieve the effects of driving away and forced landing [5].

The low-altitude aircraft defense and interference system integrates a variety of equipment such as active detection, passive detection, photoelectric monitoring, interference suppression and handheld interference suppression, and realizes the integration of "situation awareness-alarm-interference disposal" through the drone monitoring and management platform. Intelligent services enable the system to have the characteristics of combined observation, comprehensive identification, precise strike, comprehensive coverage, intelligent management and control, rapid disposal, open architecture and comprehensive guarantee [6].

The main workflow of the system is as follows:

Step 1: active detection equipment performs search and detection on the set airspace. When one or more drones enter our early warning airspace, the active detection equipment can detect the position, distance, speed, and altitude of the invading drone. Information is collected, real-time tracks are plotted on the map, and track numbers are numbered.

Step 2: passive detection equipment performs scanning and detection on the set airspace. When one or more drones enter our early warning airspace, the passive detection equipment can perform
information such as the position and signal characteristics of the invading drone. Collect and draw real-time tracks on the map and number the tracks.

Step 3: the command and control center uses active and passive information fusion, multi-station information fusion, comprehensive situational awareness and other technologies to eliminate false and interference targets, determine the nature and threat level of the intruding drone, and then automatically alarm to effectively reduce disposal. Staff workload.

Step 4: the command and control center controls the optoelectronic surveillance to target the airspace where the suspicious target is located. The optoelectronic surveillance equipment can automatically track and monitor the invading drone target at medium distances and take pictures. The monitor can accurately identify the target based on the video image taken by the optoelectronic. Provide more detailed target data for subsequent command decisions, interference strikes, and more.

Step 5: For the drones entering the key protection area, if the monitoring personnel judges that they are invading the drones, at this time, the interference will be processed to the target to achieve the effects of eviction and forced landing.

![System working principle diagram](image-url)

**Figure 1.** System working principle diagram.

The system is equipped with an automatic handling function. When the system is set to the automatic handling mode, the command and control center automatically alerts the target of the invading drone (step 3) and can automatically guide the interference countermeasure equipment to deal with the invading drone.

4. **Conclusion**

There are still many difficulties in the detection and interception of anti-UAV operations, and the development of future UAV group operations will bring more and greater challenges to the air defense system. Therefore, anti-UAV systems and their key technologies are targeted. The research is more urgent. At present, both domestic and foreign countries are in the infancy of anti-UAVs, and they are faced with bottlenecks due to uncertain technological conditions and high product costs. Facing this situation, we should focus on the development of the most needed functions, and on the basis of this, combine various means to improve the anti-UAV system.
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