Research on the linkage technology of electric power operation field video and Beidou high-precision positioning terminal

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Abstract: In order to adapt to the trend of intelligent development in power operation sites and solve practical problems such as inadequate supervision of traditional power operation sites, this article mainly studies the linkage technology between power operation site videos and Beidou high-precision positioning terminals. Based on the application scenarios of the BeiDou positioning system in power operations, this paper summarizes the linkage technology between on-site video and BeiDou high-precision positioning terminals in power operations, and concludes that this technology is suitable for safety control of personnel in power operation sites, inspection and supervision of power lines, monitoring and early warning of inclined and collapsed transmission line towers. Research has found that the linkage technology between on-site video of power operations and Beidou high-precision positioning terminals can promote the intelligent development of power operations and achieve higher precision on-site control of power operations.

1. Preface

under the background of the rapid development of global informatization, the use of the Internet of things and 5G information technology bring profound changes for the development of the power industry, beidou global satellite navigation system as the current national strategic space and space information infrastructure, not only in the social and economic development and national defense security played an important role, but also based on its high precision positioning characteristics, promote the joint development with power field operation scene, through power operation field video and beidou high precision positioning terminal linkage technology, realize the comprehensive upgrade of electric power operation system and transformation. Study the linkage technology of power operation field video and Beidou high-precision positioning terminal, and create intelligent power operation solutions, so as to comprehensively improve the fine management level of the power grid.

2. Overview of the Beidou Global Navigation Satellite System

Beidou global satellite navigation system (BDS) for China's independent research and development of global satellite navigation system, is the us GPS, Russia GLONASS the third mature global satellite navigation system, under the long-term technology development and scenario practice, its information played an important role in industry positioning, provide many users with reliable, accurate, timeliness of positioning and navigation services. The BDS has extremely high navigation and positioning accuracy. According to China's relevant strategic planning, it is expected that more than 50 Beidou satellites will achieve global coverage this year, and continue to provide more accurate information services for all banks[1]. The basic composition of the system mainly includes several parts: space section, composed of several geostationary orbit satellites, inclined geosynchronous orbit satellites and middle earth orbit satellites; ground section, including several ground stations including main control stations, time synchronization / injection stations and monitoring stations, and intersatellite link operation management facilities; user section, including basic products such as chips, modules and antennas of Beidou compatible with other satellite navigation systems, terminal products, application systems and application services.

3. The Application scenarios of the Beidou positioning system in electric power operation

In the context of accelerating the digital transformation of the power grid, the Beidou positioning system has been widely used in multiple scenarios of power operation and achieved good results. According to the actual demand of power operation, the main application scenarios of the current Beidou positioning system in power operation include the following points: First, the autonomous inspection of uav. Assist the beidou system of high precision information positioning services and drones new intelligent terminal equipment, such as the southern power grid developed the "based on beidou high precision position service drones autonomous inspection" project,

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and in the central enterprise beidou industry coordinated development platform of the power industry, the power grid production safety and equipment patrol has played an important role[2]. The second is electric power marketing. Relying on the Beidou system to realize power grid metering data collection, which is mostly used for power data collection and power equipment positioning in remote areas without signal. With the help of the Beidou module, a large number of metering automatic terminal terminals are installed, and automatic meter reading and accurate metering management are realized in remote areas, effectively promoting the rapid development of electronic settlement. The third is personnel positioning[3]. In beidou RTK differential positioning technology support, beidou positioning accuracy greatly improved, reach meters, thus realizes the real-time accurate positioning in the electronic map electric power operation site personnel information, and through the Internet of things technology, the video monitoring technology, realize the perfect linkage with the video terminal equipment, accurate control power operation field staff, in ensure the power operation is completed at the same time, also can effectively ensure the safety of operating personnel.

4. Practice of linkage technology between power operation field video and Beidou high-precision positioning terminal

4.1. Safety control of personnel on the electric power operation site

Electric power operation site environment is complex, there are serious electromagnetic interference field phenomenon, often inaccurate power equipment positioning, plus the traditional positioning way of single, the effect is poor, difficult to implement the power operation site positioning on the same equipment, which may cause serious safety problems, electric power operation site personnel safety control affected. Therefore, the safety control of the electric power operation site personnel can be realized with the help of the electric power operation site video and the Beidou high-precision positioning terminal linkage technology, so as to ensure the personal safety of the staff[4]. With the help of 5G + differential positioning technology, the Beidou RTK personnel positioning system is developed, and the personnel positioning equipment can be deployed in the positioning area to achieve accurate personnel positioning.

As shown in Figure 1, the Beidou RTK personnel positioning system mainly includes the power operation site positioning terminal, display terminal, positioning base station, etc. To maximize the beidou system accuracy, at the

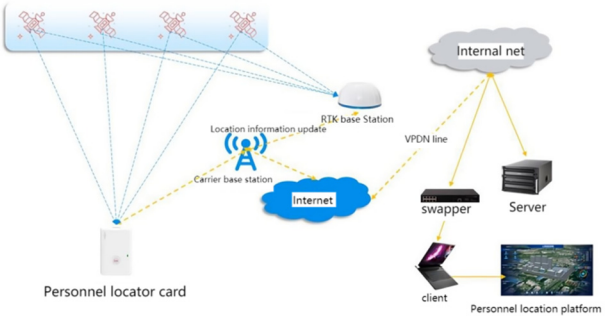

Figure 1: Beidou RTK personnel positioning system

scene of the power operation installation RTK differential positioning base station, with the help of beidou system satellite positioning data and field video terminal equipment accurate observation, calculated correction value, staff wear personnel positioning card such as positioning terminal after receiving correction value to correct satellite positioning data, in 5G technology support rapid positioning information transmission to personnel positioning platform, after information processing with electronic map for geographic location data information comparison, thus accurate display power operation site staff location. Through the analysis of the above system, we can know that in order to improve the positioning accuracy of personnel, in addition to the need to rely on the Beidou positioning system, the video terminal positioning of the power operation site is also very important. The on-site video terminal equipment used in the system mainly includes two kinds:

The first is the Qbox S30 Beidou high-precision intelligent safety helmet[5]. This is an intelligent safety helmet based on the Beidou positioning system independently developed by electric power enterprises, Including the Beidou module, lighting module and camera module, With the support of the background cloud platform, Can effectively realize the visualization and intelligent control of the electric power field operation, And with the Beidou positioning system to form the linkage of personnel accurate positioning services, Combining the 3 D digital simulation technology simultaneously, Real-time grasp of the power site staff dynamics, operation, safety protection and other conditions, Centimeter-level indoor and outdoor integrated positioning and video terminal linkage, Provide practical safety guarantee for the site staff, Record the movement track of the personnel in combination with the field operation content, So as to realize the early-warning management, Ensure the operation safety[6].

The second is the gateway + cloth ball. In the security control technology products equipped with the Beidou satellite positioning of the high precision positioning technology, The product can send information about its location, Including longitude, latitude, elevation, etc., To enable real-time positioning, Based on the location information sent and the ball control location data, Calculate the relative position relationship of cloth ball control and personnel position, Including the distance and the angle, The intelligent terminal controls the cradle head of the ball control to turn the corresponding Angle and

adjust the focal length, The linkage control of terminal positioning and video equipment in 3 D space, So as to realize the rapid search, tracking and identification of high-risk operators, To solve the problems of traditional video surveillance means of monitoring blind area and the target is difficult to find. Based on video monitoring and beidou positioning linkage of power operation site personnel control mode, can docking the current market mainstream video equipment, and keep the data format unification, to ensure that the positioning system warning, to the first time in the background system platform pop-up video monitoring images, but also support audio and video intercom function, real-time control of field staff and equipment protection, greatly improve safety management efficiency.

The main functions of Beidou RTK personnel positioning system + on-site video terminal linkage technology in the safety control of electric power operation site personnel are reflected in the following points: the basic personnel information management, Real-time query of the name, work, training and other basic information; Real-time location-based tracking, Ccentimeter-level personnel location information can be fed back to the electronic map in real time, In order to carry out real-time personnel position tracking; Query of the historical motion trajectory, Query of the historical movement track of the electric power field operators, This method provides a detailed basis for the power task backtracking; Intelligent early warning, Including electronic fence alarm, climbing operation alarm, fast movement alarm, falling objects alarm, operation navigation, etc., When the field operation personnel have abnormal conditions such as detention, crossing of line, static, Background platform system can be timely warning, And through the field camera terminal equipment to display the operation site picture, In order to carry out timely rescue; Emergency management, According to the actual location change of the staff, When there is a safety hazard to evacuate, Mark the optimal evacuation route and location on the electronic map, And guide the staff to evacuate safely.

4.2. Inspection and supervision of power lines

With the scale of the power grid continues to expand, the task of power line inspection is also increased. In the face of the heavy power line inspection task, coupled with the complex inspection environment, the routine inspection mode is no longer applicable. In communication enterprises for beidou navigation civil points service qualification, can use the beidou positioning system and 5G technology, using drones for power line patrol, beidou positioning system for uav, drones carry high-definition camera device line patrol, form the beidou system accurate positioning, unmanned autonomous patrol, image real-time 5G transmission intelligent patrol scheme[7]。

The "Beidou + 5G" uav power line inspection and supervision has played a great advantage in the work practice. The traditional manual power line inspection and supervision has heavy tasks and often takes a long time to complete the operation. In complex environments and risk areas, it needs to rely on the staff experience to carry out stable and shooting work, and the live environment poses a threat to the personal safety of the staff to a certain extent. In the current uav autonomous patrol mode, the beidou system positioning and staff operation guidance of autonomous patrol, higher efficiency, with 25km power line patrol, for example, use the drone only three hours to complete artificial two days patrol task, at the same time is not affected by the complex environment and weather, even in the charged environment, also can quickly accurate power line patrol work. The single inspection range of the UAV nest can cover 1 / 5 of the area, saving nearly 80% of the manual control time. It can not only reduce the fuel consumption caused by the operation and maintenance personnel outside inspection, but also eliminate many risks in the process of returning to the site and the site inspection, realizing the three improvements of efficiency, safety and efficiency, and laying a solid foundation for the realization of fine three-dimensional inspection of the power grid.

According to the actual demand of power grid line inspection task, power enterprises can build UAV nests, equipped with a certain number of drones. UAV nest automatic inspection on the basis of "machine nest + platform + algorithm" architecture, through the machine patrol platform, team operations personnel just move the mouse, remote control deployed at the scene of the drone nest, drones can according to the preset route automatic distribution line fine inspection, infrared temperature measurement, emergency patrol, operations staff "never leave home", can remote drones complete distribution equipment inspection work[8]. In addition, in response to the complex scenario of drone inspection operation problem, according to the power line inspection task set route and point, cruise accuracy within the scope of the cm, 5G technology can effectively improve data transmission rate, the drone itself, 32 times zoom HD visible light sensor, can capture the rich field equipment details, under the staff of the remote control command, can be collected to the scene picture data information transmission to the system platform, the next step of analysis and storage.

4.3. Monitoring and early warning of transmission line poles and towers

Power tower is an important infrastructure in the power transmission network, in the actual work process not only need to bear itself and wire load, also need to bear the tension load of transmission lines, at the same time under the influence of complex natural environment, tower itself tilt collapse accident, so in the power field operation to inspect the tilt state monitoring. Take the pilot of landslide monitoring of transmission tower based on Beidou high precision positioning technology of 220kV 4R76 line and 110kV 1831 line Jiutao 1789 line 012 # tower as an example. The case with the aid of beidou high precision positioning technology and power field high-definition camera, can real-time monitoring of tilt tower, and combined the hd camera to realize the accurate monitoring of the tower status, in the tower position changes, historical tilt data timely warning, staff can rushed to the

scene in time to carry out maintenance work. The electric power operation site video and beidou high precision positioning terminal linkage technology, is the power field module based on the miniaturization of multiple information acquisition operation, using 5G technology as information transmission technology, comprehensive guarantee information transmission timeliness and accuracy, maintenance personnel can not only precise positioning tower coordinates, at the same time also can use video picture view tower actual tilt state, effectiveness and accuracy is strong.

5.Conclusion

Overall, the linkage technology between 5G technology based power operation on-site video and BeiDou high-precision positioning terminal is the main technology for future power grid on-site operation practice. With the continuous increase in the number of BeiDou satellites, the accuracy of the BeiDou positioning system will also continue to improve. By combining with on-site video monitoring equipment, higher precision real-time power operation control can be achieved, ensuring maximum safety and efficiency of operation. Although on-site video and Beidou high-precision positioning terminal linkage technology have high practical value in power operation, there are still problems such as insufficient intelligence in actual technological development. The main problem is insufficient data collection on the behavioral characteristics of on-site power operation personnel, and insufficient accuracy in remote monitoring. There is still a lot of room for improvement and development. In the future, rules for data extraction, data cleaning and transformation, data fusion, and data storage can be established based on the data characteristics and fusion models of operators, forming heterogeneous data fusion models to process multi-source security data of power operation sites and achieve more accurate, timely, and comprehensive control of power operation sites

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