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Unmanned Aerial Vehicle Remote Sensing Monitoring and Image Acquisition System

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Abstract

Compared with traditional field measurement, low altitude remote sensing technology can greatly reduce field workload, improve mapping efficiency and lower operating cost. (compared with large aircraft, satellite) at the same time, the use of true color digital image data, designers can be more clearly visualize the status of cultivated land in land use planning, digital elevation data, the calculation can be easily carried out slope and earth volume. After the completion of land development, unmanned aerial vehicle can fly again. Through superposition and contrast, the construction and design of the project will be analyzed accurately and intuitively.

Keywords:*UAV, image acquisition, monitoring system, remote sensing platform.*.

1. Introduction

The performance of UAV remote sensing system is excellent, can according to the scheduled flight routes, flight shooting, high control precision, stable flight attitude and flight height from 50 meters to 4000 meters, 10 meters high control precision, speed range from 70 km / h to 160 km / hour, can be a smooth flight, in complex weather conditions Sichuan Province, cloudy and foggy etc., can be carried out under the cloud of aerial flight, which can work as far as possible to ensure timely and accurate completion. UAV remote sensing system of flight operation and high automation, simple operation, and automatic fault diagnosis and display function, and easy to master training, once the remote malfunction or other fault, automatic return to aircraft take-off point over, waiting, if the failure to lift, according to ground control personnel to continue the flight, otherwise automatic parachute recovery.

UAV remote sensing system is equipped with a high precision digital imaging equipment, have the technical capability of surface coverage, continuous vertical or inclined imaging, obtaining the image spatial resolution of decimeter, suitable for 1:2000 or larger scale topographic mapping and orthophoto production, so it has high resolution remote sensing image data acquisition capability.

In addition, the operation cost of UAV remote sensing monitoring system is low, the training time of flight operator is short, the storage and maintenance of the system is simple, and the cost of dispatching and stopping can be avoided.

The UAV imaging range is determined by the scope of the route planning, route and even can real-time upload several times of flight, there is still a limited perspective, monitoring scope is small, adjusting flexibility is not enough. The performance of unmanned aerial vehicle (UAV) is seriously restricted. The constraints in a certain height, how to realize the unmanned aircraft from horizon to Horizon Air Monitoring and battlefield ultra wide field, a wide range of perception, aerial panorama monitoring technology is an effective way.

2. UAV Airborne Image Acquisition System

2.1 UAV airborne panoramic image data acquisition lens

At present, the research of panoramic data collection at home and abroad mainly focuses on ground acquisition, but less on panoramic data acquisition. Ground panoramic data can be collected using a single camera rotation, multi camera (Figure 1), single camera or multi camera light collection method (Figure 2).

Figure 1. Multi camera mode

Figure 2. Fish eye lens (light collecting method)

The main basis of the classification of panoramic data acquisition technology is the difference of imaging principle of optical components. Accordingly, the panoramic data collector is divided into two categories: transmissive and reflective imaging. At present, there are five kinds of practical imaging sensors for building ground panorama, which are single camera rotation mode, multi lens simultaneous imaging, annular imaging, high-speed ball, and fish eye lens imaging. The unmanned vehicle is difficult to meet the use of single camera rotation capture panoramic data, the annular imaging scheme in front of camera images can be acquired, the fisheye lens imaging image distortion correction image is relatively large, the need for a large number of operations, through the high-speed movement of a high-speed ball to achieve the 360 degree panoramic, fast implementation 360 degree panoramic, but see a certain angle picture at a time only, so it will be blind.

The UAV aerial panorama to construct can be used for measuring the imaging lens can adopt many combinations of the main field to just below the lens as the standard, with cameras around a plurality of image deformation controllable as vice principal field center field, precise positioning, side field controllable deformation, can be roughly positioning.

2.2 Lens combination scheme

At present, there are three kinds of lens combination schemes for panoramic surveillance. They are simultaneous imaging of multiple lenses, annular imaging and fish eye lens imaging. The front of the lens in the annular imaging scheme is unable to obtain the image, image fisheye lens imaging distortion corrected image is relatively large, the need for a large number of operations, the system uses a multi lens imaging combined mode, the main field to just below the lens as the standard, to around a plurality of imaging rules (image deformation is controlled the camera field of view) - mode imaging. The video camera is composed of 6 cameras, and the camera image is transmitted to the ground by the video transmission device and is spliced by a ground computer. The transmission channel mark signal is transmitted to the ground computer by the audio channel of video transmission, and the image orientation is recognized by the computer.

Panoramic image seamless real-time splicing technology in this system is specific to multi lens seamless real-time splicing technology. Extracted from the image feature points is the first step to achieve multi lens seamless real-time mosaic, but also is the most critical step, can be obtained through image feature matching for feature extraction, these features should be distinctive, invariance, stability and effective solution to the ambiguity of matching ability. At present, there is no general extraction theory, which leads to the diversity of image matching features. Compared with image features such as geometry, texture information and color histogram, scale invariant feature points, as a local feature, have better adaptability to many image transformations. This system uses corner detection operator to extract corner feature in image, because corner feature is a kind of image feature with good stability and easy operation. The feature matching method is used to match the detected features.

2.3 The composition of UAV airborne panoramic monitoring system

UAV panoramic monitoring system is based on UAV or unmanned airship as the carrier, processing platform panoramic monitoring equipment, including two parts of airborne equipment and ground processing system, supports a wide range of monitoring and real-time battlefield target tracking and positioning, fast route planning and upload, panorama generation, fast attack effect evaluation function, system structure figure 3.


Aerial platform

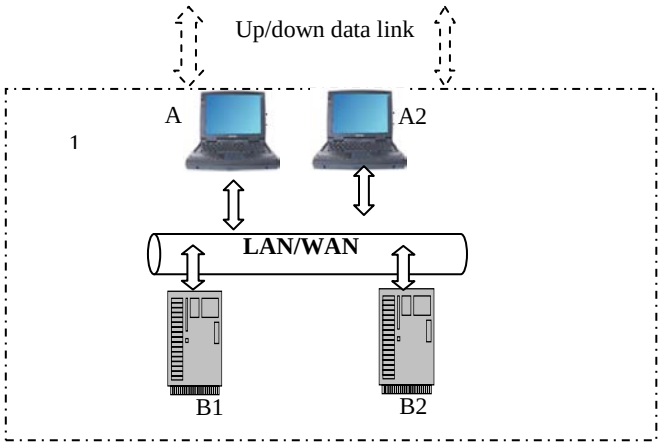

Figure 3. System structure diagram

A1 stands for ground receiving system
A2 stands for panoramic image data processing station
B1 stands for geospatial data server
B2 stands for panoramic image data server

Figure 4. Unmanned aerial vehicle operating equipment

3. Unmanned Aerial Vehicle Remote Sensing Platform Integration Technology

The structure of UAV remote sensing platform can be divided into aircraft subsystem, TT & C and information transmission system, information acquisition and processing system and guarantee system. Small unmanned aerial vehicle (UAV) is a new type of remote sensing platform with low cost. It requires small size, light weight and good shock resistance. The system consists of two parts, the head of the array CCD camera and the master computer. The CCD array camera head is used to capture and capture remote sensing images. The camera head includes three parts: the camera body, the lens and the digital back. Digital cameras are of two main types, one is the detachable array CCD digital back installed in large and medium format camera to replace the rear film digital imaging; the other is the CCD imaging module directly integrated with the body, it is our common 135 small format digital camera. The former usually has high resolution for professional photography, while the latter emphasizes convenience for home and general photography. Unmanned aerial vehicle remote sensing platform requires high resolution and small size of camera, so it adopts the scheme of large area CCD digital back with 120 medium format camera. We require higher image quality, so we must reduce the impact of the image on the image, requiring less than 0.5 pixels. If we choose the large surface array CCD back the pixel size of 9 m * 9 m, the UAV speed 33m/s, height 500m, the camera focal length is about 50mm, can calculate the camera exposure time is 1/733s, so we use the highest shutter camera should be more than 1/1000s. The main parameters of the camera lens are the focal length f, the focal length f and the FOV angle theta, and the imaging surface width L are closely related. The relation between the focal length f and the field of view theta and the size of the imaging surface L is as follows: TG (theta /2) = (L/2) /f, the correlation calculation of the focal length can be carried out according to this relation. The master computer completes the control of the camera, the transmission and storage of the image. PC/104+ embedded computer better meets this requirement, and has the advantages of short development cycle. PC/104+ embedded computer can complete the functions of exposure control, image acquisition, transmission, storage, GPS decoding calculation, remote instruction execution and status reporting in two instruments.

3.1 Real time acquisition and downlink of remote sensing data

Radio telemetry system is a state parameter of transmission of UAV and remote sensing device, can realize the aircraft attitude, altitude, speed, heading, azimuth, distance and machine power measurement and real-time display of data and graphics, with two display function. Provide ground personnel with information about UAVs and remote sensing equipment, and store all transmission information for call review at any time. The radio remote control system is used to transmit the instructions of the ground operator, and guides the UAV to fly according to the will of the ground personnel. Because of the high resolution airborne remote sensing equipment to produce a large amount of data, the real-time transmission process using high compression ratio lossy image compression technology, the error caused by limiting the application of aerial remote sensing in some areas of high standards. The real-time acquisition of remote sensing data is closely related to the downlink and multi-mode sensors, remote sensing platforms, aerial

photographic control systems, and real-time data transmission links of aircraft platforms. To achieve airborne remote sensing data transmission and compression, there are at least 3 options for consideration. The third schemes are better, so the first three scenarios are introduced here. In this scheme of multimodal remote sensing system using two data transmission link through the IPC, and the remote sensing data in the hard disk, a backup, a platform by airborne remote sensing control board I/O interface into the remote sensing data compression module, data compression. The compressed data is transmitted over the airborne remote sensing platform and the control board data transmission line, and the UAV data transmission equipment realizes data to ground transmission.

UAV remote sensing image on the imaging records stored in digital form; airborne remote sensing platform in remote sensing data read by the I/O device, remote sensing image data communication program to remote sensing platform on the control panel in BMP format from the DSP board wrote in memory; BMP image data of DSP data compression module board will gain compression JPEG image data and JPEG image data generated writes the specified memory; then the data communication program from the specified memory DSP card for JPEG compressed image data, sent to the UAV data link.

3.2 Ground reception and processing of remote sensing data

Ground receiving and processing of remote sensing data is an important component of UAV aerial remote sensing system. The remote sensing data receiving and processing and processing requires the establishment of fixed and mobile ground data receiving station; establish and manage the massive data storage and distribution capabilities of the data center, the establishment of image database; radiation correction of image data; according to the aircraft and sensors and external characteristics of geometry element deformation caused by the basic geometric correction, using the ground control points for accurate geometric correction, image data can be used as a GIS template. With the global positioning system GPS into a fully operational stage (FOC) and the application of high repetition frequency laser ranging technology, GPS positioning technology, inertial navigation technology (INS), laser ranging technology was integrated by airborne scanning laser terrain system has become one of the research hotspot in remote sensing field, and then the remote sensing images with synchronous machine or get the location information, it is completely out of control on the ground, save a lot of manpower and material resources, thus greatly improving the work efficiency of remote sensing.The obtained 3D ground surface images are shown in Figure 5.

Figure 5. 3D terrain panoramic image

4.Conclusions

The UAV imaging range is determined by the scope of the route planning, there is a limited perspective, monitoring scope is small, adjustment is not enough flexibility, seriously restrict the effectiveness of unmanned aircraft perform the monitoring tasks. Based on the analysis of current air panoramic monitoring technology, the establishment of a UAV panoramic monitoring system, presents the key technologies to realize the system, realized the aerial panorama monitoring large-scale and ultra wide field of view.

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