Design and Research of Satellite Communication Terminal System

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Abstract. Under the condition that the local facilities are completely destroyed and the use site changes frequently, it is of great significance to realize the rapid and convenient establishment of satellite communication links at both ends of the ground to meet the emergency communication. A kind of fully automatic portable satellite communication terminal is designed, which integrates the common satellite communication terminal equipment highly, integrates the hardware and software of each equipment, completes the link of satellite communication link and parameter setting by using the keyboard operation of laptop computer, and can automatically complete the process of satellite searching. It can improve the accuracy of the alignment satellite, ensure the excellent communication performance, light weight and portability, and is suitable for use in various harsh environments.

Keywords: Satellite Communication, Link Communication Terminal Equipment, Automatic Star Finding, Satellite Alignment

1. Introduction
In the mobile satellite communication system, the user segment needs to access the mobile satellite communication network through the ground segment for mobile communication. The communication terminal on behalf of the user segment can have different forms, such as hand-held terminal or vehicle terminal, etc. The user terminal is used to set, acquire and complete the communication by installing a wireless transceiver antenna. For the mobile satellite communication network of different frequency bands, one of the embodiments is that the user terminal uses different frequency. The user terminal that uses different frequency band to communicate has different communication functions and design methods. There are many manufacturers developing satellite communication products at home and abroad. The first generation of satellite communication adopts fixed station or VSAT station, which is simple in general and single in function. In the second generation, the satellite communication earth station is installed on the vehicle platform, and becomes a mobile satellite communication station. In the second generation, the satellite communication earth station has the function of satellite control and mobile. Each main unit of satellite terminal includes satellite transmission unit, image coding unit, voice coding unit, etc. all of them are combined in a portable box [1-4]. The terminal provides rich data
interfaces for computers, cameras and other external devices to access the terminal. The RF output and input of the terminal can be in different frequency bands, which can be adapted to various mainstream antenna units at home and abroad. Satellite communication portable terminal provides users with a portable multi service satellite communication platform, which makes it convenient for users to establish satellite communication links with command center or other terminals to transmit image, voice, data and other services no matter where they are. With the development of communication satellite technology, Ku band communication transponder is widely used. Due to the increase of communication frequency, the size of antenna surface is relatively small. In order to adapt to the development of the situation, solve the problem of on-site emergency communication which is convenient and fast to reach the places where traffic is inconvenient, and in recent years, there have been frequent emergencies. In recent years, there have been many emergencies and natural disasters in the world, such as Wenchuan earthquake, forest fire and so on. Now there are products on the market, and the demand is rising.

At present, the main foreign satellite communication system is the vehicle borne sky service system. Generally, the antenna aperture is less than 1 meter, the material is aluminum or fiberglass, and the control system uses more industrial computers. It makes the system bulky and inconvenient to carry. The most important thing is that the price is expensive and after-sales service cannot be guaranteed. The main domestic vehicle satellite communication system, although the product has a certain price advantage, but there are also obvious shortcomings, such as low operating frequency band, slow antenna speed and limited range of motion. At the same time, there are problems such as low resonance frequency, long time of initial acquisition and re-acquisition, and less traffic.

In order to solve the above problems, the satellite communication terminal researched in this paper needs small size and high strength. At the same time, the intelligent degree is high, the operation is simple and convenient, no need for professional control. The communication bandwidth is large enough to ensure the transmission of large capacity multimedia in emergency scene, such as image, data, voice, etc.

2. System design

2.1 Structural design
Small satellite communication terminals are mainly used for communication support of emergency relief. When there is a disaster in some areas or areas that cannot be covered by conventional communication or the existing communication network is damaged and unable to establish contact with it. In this case, how to transport the small satellite communication earth station to the scene of the disaster area, without regional and environmental restrictions, and establish a satellite communication link, communicate the contact between the scene of the disaster area and the emergency rescue command department is very important.

The system antenna reflector and antenna pedestal are made of carbon fiber aviation materials with light weight and good strength. The antenna surface adopts the split structure to reduce the collection volume. The supporting parts are made of light aluminum profile to reduce the weight. The main structural components of the system, antenna reflector, and antenna pedestal and antenna pedestal support are simulated and optimized, and the overall design weight is less than 18kg, which can be carried by one person. Therefore, in any terrain can quickly expand, automatic start and tracking, within a few minutes to establish a satellite link, to achieve remote data transmission and real-time video transmission. [5-9]

2.2 Wireless control panel
STC microprocessor is used as the control center to control the wireless module swr1011 circuit, key detection circuit, low-voltage detection circuit, LCD display circuit, system indicator circuit, etc. The structure of wireless control panel controlled by satellite communication antenna is shown in Figure 1.
The wireless 433M transceiver module of the wireless control panel can communicate with the main control panel wirelessly, and the system can be set to communicate wirelessly at different frequencies. With low-voltage detection function, when the power supply voltage is less than 1.33V, the system will output alarm information to the LCD and automatically stop working. The use of LCD with Chinese characters, to achieve a friendly human-computer interface display.

2.3 Acquisition and tracking satellite technology
In order to capture and track the satellite quickly and accurately, the system uses Beidou / GPS positioning, electronic compass to measure the antenna attitude, and high-precision angle sensor to detect the antenna space angle position. The relative position of the antenna and satellite is determined by the algorithm of comprehensive position solution. The antenna servo drives the antenna to point to the communication satellite with the three axes of antenna orientation, pitch and radio wave polarization. Through gradient tracking method, extremum guided antenna pointing and integrated data fusion to correct the error, the time for antenna to accurately track the communication satellite to capture and track the satellite is less than 80 seconds, and the tracking accuracy is less than 0.08 °. Antenna detection completes the detection of antenna angle position and antenna carrier attitude information. The antenna angle position detection unit includes the real-time detection of the elevation angle of satellite communication antenna and the real-time detection of the azimuth angle of satellite communication antenna.

2.4 Operation control technology
The intelligent operation control technology with simple command control is selected for various operations. The parameters of the system, such as satellite position, radio wave polarization and frequency, are pre placed with one key to control the intelligent operation and wireless remote operation to operate automatically. The upper computer access parameters can be configured to operate automatically through remote control of the network. In case of emergency, it can be transported to the designated site with people's burden. Through simple erection and deployment, a control method can be used to quickly track the designated satellite to establish a satellite communication link [10-13].

3. Design results
The backpack portable satellite terminal system is small in size, light in weight, and the whole system is integrated in a box. The antenna working structure, antenna load statuses are shown in figure 2 (a) and (b), and satellite communication terminal collection status are shown in figure 3.
Figure 2. The status of antenna

Figure 3. The collection status of satellite communication terminal

After the test, the weight of the system is less than 16KG, which can be carried by hand. It is easy to install on site and can be used without site debugging and any auxiliary facilities. One person can complete the antenna alignment within 3 minutes. The use site is unrestricted. In case of emergency, it has strong mobility and can be used in any situation. With the antenna automatic tracking technology, it can complete the automatic star alignment within 3 minutes without the need of manual star alignment, and can fully meet the communication requirements in emergency situations.

4. Conclusions

Through the integration of the key technologies of satellite communication terminal and antenna system, the Beidou / GPS satellite positioning, attitude measurement and angular position detection are applied to realize the rapid acquisition and accurate tracking of satellite targets by the antenna. Using high-performance carbon fiber material technology, through the overall optimization design and fine manufacturing technology, the antenna system can achieve rapid development and lightweight, portable and shouldering performance. It has the advantages of high strength, high precision, high reliability, light weight, easy to carry, transport and so on. It can solve the problem that when an emergency occurs, it can carry a single person to the scene where a person can enter, and quickly establish a satellite communication link.

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