



Research and Analysis of Distributed Machine for Aviation Cable Testing System Based on CAN Bus

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Abstract

The distributed machine based on CAN bus for aviation cable testing system is an emerging technology widely used in fields such as aviation cable testing. Efficient communication between multiple test nodes can be achieved through CAN bus, which can achieve full testing of cables and improve the quality of cables. This technology has advantages such as strong reliability, scalability, and efficiency. Therefore, there is an urgent need to study and analyze the distributed machine of aviation cable testing system based on CAN bus. In this constantly developing and advancing technological era, the distributed machine of aviation cable testing system based on CAN bus, as a highly practical technology development field with increasing demand, needs to strengthen research and analysis to promote its rapid development and application.

Keywords

CAN bus; Aviation cables; System distribution machine

In practical applications, it is necessary to conduct in-depth research on the CAN bus communication protocol, collaboration between test nodes, data transmission, and anomaly detection. For example, it is necessary to explore the characteristics and advantages of the CAN bus protocol, and how to establish a communication protocol suitable for high-performance cable testing. In addition, it is necessary to understand the design of data interaction and communication protocols between test nodes and test platforms, as well as the design and implementation of functions such as adding and deleting test nodes. At the same time, in practical applications, it is also necessary to pay attention to the detection and repair technology of node faults, and how to simplify operations, improve test efficiency, and reduce test costs during the test process. With the continuous development of technology, this technology will become an indispensable technical means in the field of aviation cable testing.

1. Overview of the CAN Bus-based Aviation Cable Test System Distributor

1.1 The aviation cable test system

The aviation cable test system is an automated system for testing aviation cables. The test scope of aviation cables is relatively wide, including open circuit test, short circuit test, resistance test, capacitance test, inductance test, insulation test and other aspects. These tests require instruments to analyze and evaluate the cables. Traditional cable testing methods mainly rely on manual testing and separate testing instruments for testing, which are inefficient and cannot meet the needs of high efficiency and automated testing of modern aircraft. For this reason, it is becoming increasingly urgent to study and design an aviation cable test system that can realize automated and digital testing. The aviation cable test system needs to improve the test efficiency and eliminate human intervention as much as possible while ensuring the accuracy of the test. Reliability and accuracy are also prominent issues of the system. Based on this, the aerospace cable test system is usually a system composed of multiple hardware and software modules, and its main task is to measure and analyze aviation cables.

In terms of hardware, the system usually uses high-performance data acquisition equipment and data transmission equipment based on the CAN bus. The data acquisition equipment collects and processes the aviation cable signals

through electrical measurement technology, and uses the CAN bus interface for data transmission to reduce test errors. In terms of software, the software of the aviation cable test system needs to realize basic test functions, such as signal processing, test result determination, retention, display and other functions, as well as advanced functions such as batch processing, control 32 switches, analysis and statistics. Therefore, the software system of the test system generally takes into account factors such as application convenience, high efficiency of data processing and test analysis, and real-time test exception handling.

1.2 Principle and application of CAN bus

CAN bus is the abbreviation of controller area network. It is a field bus widely used in the fields of robots, automobiles, industrial automation, etc. It has many advantages in reliable data transmission, high transmission rate, long transmission distance, strong anti-interference ability and high data reliability, so it is widely used in the control and transmission field of complex systems. CAN bus adopts a multi-master-slave architecture, and realizes data transmission between multiple nodes through the combination of physical layer and protocol layer. On the CAN bus, each node is equal, and there is no master-slave distinction. Communication between nodes is carried out through data frames.

The data frame of CAN bus is composed of multiple parts such as start bit, control bit, data bit and check bit. The start bit indicates the beginning of the data frame, the control bit contains some control information, the data bit is used to transmit data, and the check bit is used to check the correctness of the data. The communication rate of CAN bus can reach hundreds of Kbps to several Mbps. Depending on the number of nodes and the length of the bus, the communication distance of CAN bus can reach several kilometers.

CAN bus is widely used, including robots, automobiles, ships, aviation and other fields. In the field of robotics, CAN bus is commonly used for robot control and transmission, including motion control, sensor signal acquisition, speed control, etc. of various robots [1]. In the automotive field, CAN bus is mainly used for control and transmission of automotive electronic control systems or automotive networks, including control of in-car sound, lighting, air conditioning, etc., as well as control of engines, transmissions, brakes, etc. In the aviation field, CAN bus is commonly used for aircraft control and transmission, with functions including flight control, data acquisition, heading control, etc.

2. Hardware Structure of the Distribution Machine

2.1 Detection module

The detection module is one of the key components of the aviation cable test distribution machine. It mainly uses components such as digital signal processor (DSP), high-precision analog-to-digital converter (ADC), and multi-way switch to perform signal detection and analysis to determine the performance and problems of the cable and achieve high-precision, high-speed signal processing and acquisition. Specifically, the detection module mainly includes the following modules:

(1) Analog-to-digital converter ADC is the core part of the detection module, which is used to convert analog signals into digital signals for digital signal processing. In cable testing, ADC is mainly responsible for sampling, quantizing, encoding and other processing of analog signals for further digital signal processing and analysis.

(2) Digital signal processor DSP is another key part of the detection module, which is mainly used for digital signal filtering, gain, FFT analysis, adaptive digital filtering and other processing. By processing digital signals, DSP can perform noise reduction, analysis, preprocessing and other operations on the signal, making subsequent data processing more accurate and precise.

(3) Multi-way switch, which can control the switch state of the signal path, thereby controlling the sampling and transmission of the cable signal. The multi-way switch is usually controlled by a digital input/output (I/O) port, which can control different signal paths according to the requirements of different test tasks to achieve different cable testing requirements.

2.2 CAN bus interface circuit

The CAN bus interface circuit is the main channel for data transmission in the aviation cable test distributor. It uses the CAN bus protocol and is responsible for realizing data exchange and sharing between the nodes of the aviation cable test distributor [2]. The design of the CAN bus interface circuit needs to take into account the requirements of communication rate, stability, reliability, anti-interference, etc. A CAN bus connection is established between all

nodes to link all devices together and realize data transmission and exchange between devices. The bus interface circuit is required to have high speed, high stability, low latency and strong anti-interference performance. Its design generally includes the following components:

(1) CAN controller: used to control the transmission and reception of all data, control the transmission rate of the bus, and complete the transmission and reception of CAN messages according to software or hardware commands. ASIC chips can meet different requirements such as high-speed or low-speed CAN buses.

(2) CAN transceiver: CAN transceiver plays the role of signal conversion and isolation, interconnecting the data communication components on several nodes with the bus to ensure correct and efficient data transmission between each component in the CAN network. Transceivers that can support multiple CAN protocols can also adapt to multiple CAN bus implementations.

(3) CAN interface circuit: CAN interface circuit is also an important component of CAN bus interface circuit. Its main function is to receive and send CAN information. The design of CAN bus interface circuit should also take into account the implementation of upper layer protocols, such as CAN open.

2.3 Data acquisition circuit

The data acquisition circuit is the key part of the aviation cable test distribution machine to realize data acquisition. It is mainly responsible for collecting the data, signal and energy information of the tested cable, and converting this information into digital signals for processing and analysis by computers or other devices. The design of the data acquisition circuit needs to consider many requirements, such as stability, accuracy, dynamic range, signal locking ability and anti-interference. The data acquisition circuit should be able to collect and digitize a variety of different cable signals, including voltage, current, power, frequency and other signals involved in the test work.

The input module mainly includes sensors or measuring instruments, which can collect signals generated by the cable, such as voltage, current and other parameters. According to the needs of the test task, the input module can include multiple sensors. The second is the signal amplification and filtering module, which can amplify and filter the input signal to make it easy to process and improve the accuracy of the data. The analog-to-digital converter module is mainly responsible for converting the input analog signal into a digital signal and adjusting parameters such as sampling frequency and quantization accuracy. Secondly, the digital signal processor module can filter, reduce noise, analyze waveforms and other operations on the collected digital signals to further improve the accuracy and reliability of the data.

3. Advantages of the CAN-based Aviation Cable Test System Distribution Machine Application

3.1 Efficiency

Efficiency is one of the important advantages of the CAN-based aviation cable test distribution machine application. Through the CAN bus, each test node can quickly and stably transmit and share data. In this way, efficient testing can be achieved in terms of time and resources. The CAN bus protocol has high speed, low latency, and extremely strong anti-interference performance, which makes the entire test process more efficient and reliable. The CAN bus protocol uses a priority-based frame allocation method instead of the traditional polling method, so each node can handle tasks in a more independent and disordered manner, thereby improving the processing efficiency of the entire test process. In addition, in the CAN bus network, multiple distributed nodes can also work together at the same time and share test tasks, which has high value and applicability in actual engineering application scenarios [3]. For example, when testing the wire harness in an aircraft, each test node can independently complete the test tasks in its own field, thereby achieving comprehensive and accurate test results more quickly.

3.2 Scalability

Scalability is one of the important advantages of the CAN-based aviation cable test distribution machine application. On the one hand, the CAN bus protocol is open and scalable, which makes it easy to upgrade and expand the system. On the other hand, the design of the aviation cable test distributor is also very flexible and adjustable, and test nodes and devices can be freely added or removed according to specific test requirements. In this case, the use of CAN bus technology can achieve a plug-and-play architecture, which can easily add new test nodes and devices. In addition, the widely used CAN bus protocol can also smoothly integrate CAN communication technology with existing systems, equipment and technologies through field bus upgrade technology, and achieve protocol compatibility and network expansion. Therefore, CAN bus technology can meet the high requirements of the

aviation cable test distributor system for easy scalability.

At the same time, because the CAN bus communication protocol itself is widely used, its related hardware equipment and software tools are also rich [4]. This also makes expansion and upgrading easier and more convenient. For example, when a new test node is added, the relevant device driver can be easily added to the existing system without modifying the hardware or software configuration of the entire test platform. In this way, not only can the flexibility and scalability of the system be greatly improved, but also the infrastructure investment of the test platform can be reduced.

3.3 Reliability

Reliability is one of the important advantages of the application of aviation cable test distribution machine based on CAN bus. The CAN bus protocol is optimized on the basis of the design of separating data bus and signal line. It performs very well in anti-interference, anti-electromagnetic interference, stability and reliability. The aviation cable test distribution machine system built on CAN bus can also ensure the accuracy of test data and the reliability of test results through CAN bus protocol communication.

First, at the physical level, CAN bus adopts anti-interference design. Its data bus and backup communication bus are designed as parallel twisted pair structure, which can effectively resist interference such as EMI/RFI and ensure the stability and accuracy of data transmission. At the same time, CAN bus protocol provides detection mechanisms such as plug change self-check and line break self-check, which can detect errors at any time so as to repair them in time.

Second, at the software level, CAN protocol ensures the timing relationship of data transmission by defining priority. The data with the highest priority can be transmitted first. When errors may occur in some tasks that must be transmitted, the system can also give priority to the tasks with the highest priority, thereby ensuring the real-time and reliability of the entire system. Through the CAN bus communication protocol, fast response and fast scheduling between nodes can be easily achieved [5]. During the entire test process, efficient and stable data transmission and sharing can be carried out between each node, which can ensure timely and accurate data transmission and processing, and improve the reliability of the test process.

4. Conclusion

In summary, the aviation cable test system distributor based on CAN bus is a very forward-looking and practical technology. The aviation cable test system distributor based on CAN bus has broad application prospects. It can improve the controllability of cable testing and fully guarantee its safety and reliability. Through the CAN bus, efficient communication and data sharing of multiple nodes can be achieved, and the full test of the cable can be realized, which improves the quality and reliability of the cable.

Therefore, in the future, we should pay attention to the research on the CAN bus communication protocol, further improve the testing technology, make its application range wider, and make its application effect more outstanding.

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