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Design and Implementation of Current Monitoring System Used in Ship-borne Radar

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Abstract. On the basis of analyzing some defectiveness in motor current monitoring of current radar servo system of ship-borne, design was proposed to monitoring motor current base on LabVIEW and PCI-1712 data acquisition card. The feature and driver function of DA data acquisition card are explained in detail. The data acquisition, data processing, output of graphics, alarm function, database and report forms are introduced on experimentation of moment.

Introduction

The ship-borne radar antenna servo system is generally composed of three rings, from outside to inside are position loop, velocity loop, current loop. Antenna drive system generally refers to something within the speed loop, in principle, the antenna drive system is essentially a current speed dual closed-loop SCR DC speed control system to achieve a variety of motion control of the antenna drive actuator, the main completion Power amplification, energy conversion, security protection, and ultimately for the position control to provide a good control object. Antenna drive system mainly by the drive amplifier, loop control and protection circuit and installed in the antenna on the implementation of motor, sensor and other components, of which the most important component is the implementation of motor and power amplifier.

Drive motor current value is an important parameter of the drive motor; its value reflects the antenna drive system or antenna load part of the state. When the antenna drive system problems or failures, the power amplifier output current value of the motor will be abnormal, and thus reflected in the motor current; when the antenna load mutation, in particular the structural part of the fault occurs, the current value will appear at this time A wide range of fluctuations, so the motor current value of the monitoring and recording is extremely important. At present, the shipborne radar antenna servo system uses six DC motors, of which four position, pitch two, the current monitoring mainly rely on digital ammeter for manual monitoring, because the digital ammeter refresh rate is low, can not visually display the current real-time changes, While the motor current value can not be recorded in real time, resulting in equipment failure or hidden trouble can not provide a basis for reference. In order to solve the shortcomings of current monitoring in servo drive system, a set of motor current monitoring system is designed, which can realize real-time acquisition, transmission, curve display and fault of motor current data through the human-computer interaction system composed of host computer or LCD screen and touch screen. Alarm and other functions.

Real-time data acquisition and real-time reliable transmission is one of the core parts of the whole system. The transmitted data can be divided into real-time data information and non-real-time data information. Because the motor current value belongs to the real-time data, this kind of data transmission speed request is higher. RS-232 serial communication is widely used, but its communication rate is low, transmission distance is short, anti-interference ability is poor, so the system uses PCI-1712 high-speed multi-function PCI bus data acquisition card sampling of six sampling channels, At the same time through Labview to achieve the current data curve display, recording and alarm functions.

Design of system hardware

The main function of the current monitoring system is to collect, process and display the drive motor current, in addition to fault alarm, data logging. The hardware part of the system is mainly

composed of computer, PCI-1712 board, signal conditioning circuit and Hall sensor, to complete signal acquisition, conditioning, amplification, output and other functions. The overall system block diagram is shown in Figure 1.

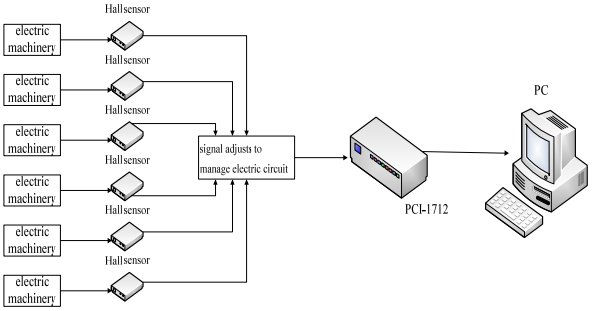

Figure 1. System overall block diagram

Data acquisition card.

Signal acquisition is a key part of the system hardware, the system uses YH manufacturers to provide PCI-1712 acquisition board. PCI-1712 is a high-speed multi-function PCI bus data acquisition card, it has 1M conversion speed 12-bit A / D converter with a FIFO buffer on the card (which can store 1K A / D sampling value and 32K D / A Conversion data), to provide 16 single-ended or 8 differential analog input (also single-ended differential mixed use), 2 12-bit D / A analog output channels, 16 digital output channels and three 10M Hz Clock 16-bit multi-function counter channel, fully meet the needs of the system high-speed data acquisition. The PCI-1712 is a plug-and-play device that fully complies with PCI Specification Rev 2.1. When installing the card, the user does not need to set any jumpers and DIP switches. In fact all the bus-related configuration, such as base address, interrupt, by the Plug and Play function automatically. The trigger source can be either analog or digital. The analog trigger signal can be generated by a dedicated input pin.

Signal conditioning circuit.

Signal conditioning circuit is a signal conditioning auxiliary circuit, through the multi-channel Hall sensor to detect the physical quantities of various measured signals, and from the mixed signal to extract the weak signal to be measured, and then amplified by the power amplifier. At this point the output of the multi-channel signal is amplified and filtered after the standard signal conversion, through the acquisition card analog input channel (AI) into the computer for processing. The sensor output is connected to the Analog Input Channel of the PCI-1712 via the ADAM-3968 terminal block. The 68-pin PCI-1712 and ADAM-3968 (68-pin SCSI-II terminal blocks) are connected to the PCI-1716 and ADAM-3986 (68-pin SCSI-II cables with two pin connectors) Of the 68 terminals, one by one, by connecting the input signal to the terminal to test the PCI-1712 pin.

Hall sensor.

Hall sensor is based on Hall Effect produced a magnetic field sensor. Its working principle is: When the original side of the wire through the current sensor, the primary current will produce magnetic lines of force, the primary magnetic lines concentrated around the core, built-in core air gap in the Hall electrode can produce and is proportional to the primary magnetic field lines The voltage is only a few millivolts in size, and the electronic circuit converts this tiny signal into a secondary current, which is proportional to the input signal (primary current). If the output current passes the measurement resistor, an output voltage signal of a magnitude of several volts proportional to the primary current can be obtained. This system adopts the R series Hall sensor manufactured by Shaanxi Ruijin Technology Development Co., Ltd. It has the advantages of sensitive to magnetic field, simple in structure, small in size, wide in frequency response, large in output voltage and long in service life.

Design of system software

The system is designed with LabVIEW software. LabVIEW (Laboratory Virtual Instrument Engineering Workbench) is a kind of virtual instrument software development tool based on G language (National Language Company). It provides designers with a convenient, easy-to-use

design environment that allows designers to easily build a measurement system and construct their own instrument panels, just like building blocks. It has a flexible program debugging tools, a powerful library, support for a variety of system platforms; you can connect with external code or software, and other advantages. In the development of the system using the data acquisition card provided by YH's LabVIEW board driver function, can be convenient and fast to complete the data acquisition.

The software development, PCI card will be inserted into the PCI slot, the computer automatically scans the hardware and automatically assigns the address to the hardware, and in the Hardware Explorer can see the YH board icon, said the computer has been identified to the hardware . Then install the board driver, the driver compatible with a variety of programming languages, select LabVIEW to install. After the installation is complete, add the control board in the toolbox, when you write the program you can call the board control and library functions to control the board. Figure 2 shows the current monitoring system software interface.

Figure 2. software interface of current monitoring system

Data acquisition program.

As Labview can not directly access the hardware, but it can create a dynamic link library card provides a driver function, to achieve the I / O access and control. In the Windows environment using the dynamic link library, you need to add a module in the project "Driver.bas", the module defines the PCI-1712 all constants, global variables, parameter declarations, dynamic link library functions, data structures. You can directly call the file in the program defined parameters to achieve data read. The main steps are as follows:

(1) Turn on the device

```
ErrCde=DRV_OpenDevice(DeviceNum, DriverHandle)
```

Where DeviceNum is the device number and DevieeHandle is the handle.

(2) Parameter settings

```
ErrCde = DRV_MAIConfig(DriverHandle, ptMAIConfig)
```

DevieeHandle for which the handle, ptMAIConfig structure used to set various parameters, including the number of channels used, the beginning of the channel number and the gain of each channel.

(3) Read data

```
ptMAIVoltageIn.NumChan = ptMAIConfig. NumChan// Number of channels
ptMAIVoltageIn.StartChan = ptMAIConfig. StartChan// Start channel
ptMAIVoltageIn.GainArray = DRV_GetAddress(ptMAIConfig. GainArray)// Channel gain
ptMAIVoltageIn.TrigMode =AiCtrMode// Trigger mode
ptMAIVoltageIn.VoltageArray = DRV_GetAddress(voltage(0))// Read the voltage value
```

(4) Turn off the device

```
ErrCde = DRV_DeviceClose(DriverHandle)
```

DMA trigger mode.

I-1712 card provides three programming methods, namely software trigger mode, interrupt mode and DMA mode. As the data collection requires a high rate, so the design of the data transfer using DMA means that the direct memory access means, compared with the traditional MCU control ADC data, the use of DMA data exchange can make data transfer from the Card to memory, from memory to adapter card or from a memory to another memory. Use it for data transfer does not

require CPU participation. Each computer has a DMA controller on its motherboard, which is usually programmed by a computer and uses a ROM on the adapter to store programs that control DMA transfer of data. Once the controller initialization is complete, the data transfer, DMA can be separated from the CPU, the independent completion of data transmission. This can be a good data transmission and system control separately, increasing the data transfer rate, reducing the burden on the processor and improve the system operating efficiency. Figure 3 for the DMA transfer flow chart.

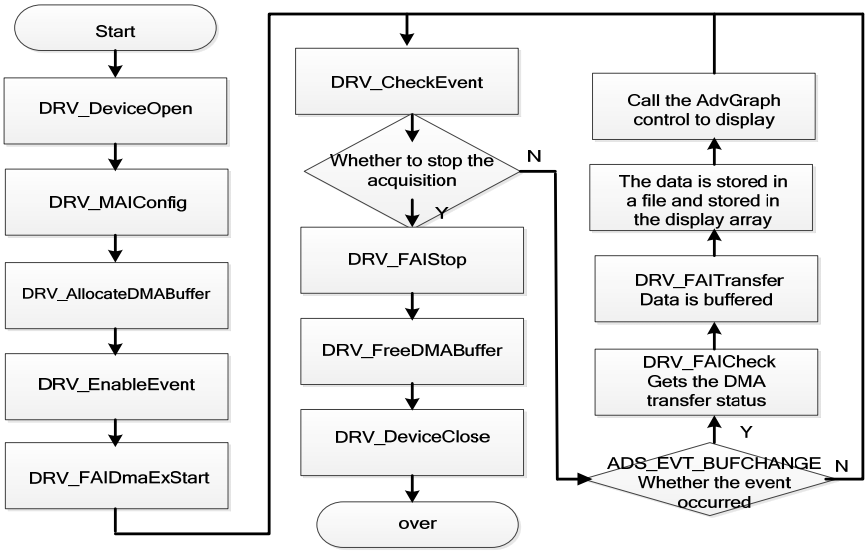

Figure 3. A transfer flow chart

Digital filtering.

In the actual signal acquisition process, due to external interference, acquisition card hardware circuit itself is not ideal and other factors, the collected signal will be mixed with a certain noise, so in order to get more accurate waveform, we must deal with the noise. PCI-1712 data acquisition card itself has a filter function; the program is cured in the board, on this basis, the system using Labview software using the median filter method to increase the filtering function to display more accurate waveform.

Error alarm.

After collecting the voltage data, the computer converts the real-time current into the motor according to the performance parameters of the Hall sensor and can set the current alarm door according to the working environment of the antenna (including the wind speed, wind direction and ship information) Limit, once the motor current value exceeds this threshold, the corresponding status indicator will change, while the alarm information is displayed in the log window.

Database implementation.

This module is to use LabVIEW SQL Toolkit and with the core program to complete, in dealing with the database, the use of general-purpose VI can quickly achieve the basic functions of the database query storage.

Record the output.

Through the NI Microsoft Report Toolkit to generate the record is saved as EXCEL format and detailed changes in the current process of recording, set the print record function, to better meet the engineering needs.

Summary

Real-time current data can be acquired, converted and processed using the PCI-1712 capture card and LabVIEW processing functions, as well as a rich set of monitoring systems to monitor the current status of the antenna servo system. This provides the equipment troubleshooting Reliable data support, while software-friendly interface, simple operation, can greatly improve work efficiency.

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