THE SYSTEM OF VIBRATION SIGNALS MEASUREMENT BASED ON VIRTUAL INSTRUMENT TECHNOLOGY

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ABSTRACT :

Measuring vibration signals plays an important role in seismographic observation. A system based on virtual instrument is introduced that can measure vibration signals. The hardware-developing of the system includes vibration sensors, a signal amplifier, a data acquisition device and a PC. LabVIEW is a figure programming language and is used as software-developing platform of the system. It is the product of National Instruments Corporation. By the LabVIEW, the system can measure and analyze the vibration signals more thoroughly and more conveniently. It is well established for its flexible operations and powerful functions. The paper presents a new development direction of vibration signals measurement.

KEYWORDS: virtual instrument, LabVIEW, vibration signals measurement

1. INTRODUCTION

Vibration is a normal physical phenomenon, such as vibrations of earthquake, mechanical vibrations of equipments and those of bridges. Acquiring and analyzing the vibration signals play an important role in seismographic observation. Traditional vibration measurement systems mostly adopt electronic instruments. Their single function and worse flexibility have restricted the limits of vibration measurement.

Virtual Instrument (VI) has developed with the rapid development of computers. VI virtually implements and expands the functions of instruments by utilizing the advanced computer technology. VI can program virtual panels by its software. Through the panels, VI can acquire, analyze, process, even display the data.
Based on LabVIEW, a virtual instrument system is designed to measure and analyze vibration signals. It can rapidly reflect the vibration parameters. Also it can analyze the signals according to the actual requirements. Compared with the traditional measurement instruments, this system can generally be extended or customized. Besides above all, this system has other advantages, such as shorter development period, lower cost, more convenient maintainability.

2. THE HARDWARE UNIT OF THE VIRTUAL VIBRATION SIGNALS MEASUREMENT SYSTEM

The components of the system are illustrated in Figure1. It consists of a vibration sensor, a signal amplifier, a data acquisition device and a PC. The vibration sensors can pick up the measured signals and output them by converting the non-electrical quantities to electrical quantities. Then the signal amplifier boosts the output level of the vibration sensor to better match the data acquisition device. The data acquisition device can acquire the boosted signals and send them to the PC to analyze and process them by software.

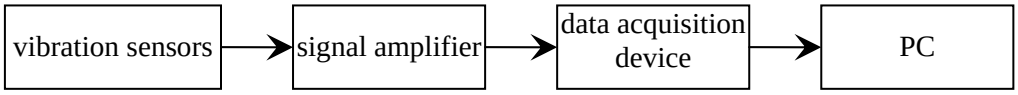

Figure1 The components of the system

Because the data acquisition of NI is more expensive, the system uses a unit based on DSP (Digital Signal Processor) to acquire the data of the vibration sensor. RS-232 serial port is used to communicate between the DSP and the PC. By the software LabVIEW, PC can control and display the data acquiring. Via the programming unit and hardware circuit of the DSP, even the interface of LabVIEW, the system realizes data acquisition of the vibration sensor. The paper emphasizes on the software unit based on LabVIEW.

3. THE SOFTWARE UINT OF THE VIRTUAL VIBRATION SIGNALS MEASUREMENT SYSTEM

The software unit of the system can realize data acquisition, controlling and driving the interface. Also it can analyze and process the measurement signals.

LabVIEW（Laboratory Virtual Instrument Engineering Workbench）, based on Graphic Language, is a kind of opening platform and developing tool about Virtual Instruments（VI）. Due to its powerful function module and communication protocol, LabVIEW greatly reduces the software development period. Especially in measuring and controlling systems, it can acquire and analyze data conveniently.

The software of the system programs by the powerful VISA of LabVIEW. VISA (Virtual Instrument Software Architecture) is a standard I/O API for instrumentation programming. VISA can control GPIB, serial, USB, Ethernet, PXI, or VXI instruments, making the appropriate driver calls depending on the type of instrument which the user use, so the user do not have to learn instrument-specific communication protocol. LabVIEW has 5 serial communication VIs and they can be found through the path “Functions Instrument I/O Serial”. A block diagram of data acquisition via serial port is illustrated in Figure 2.

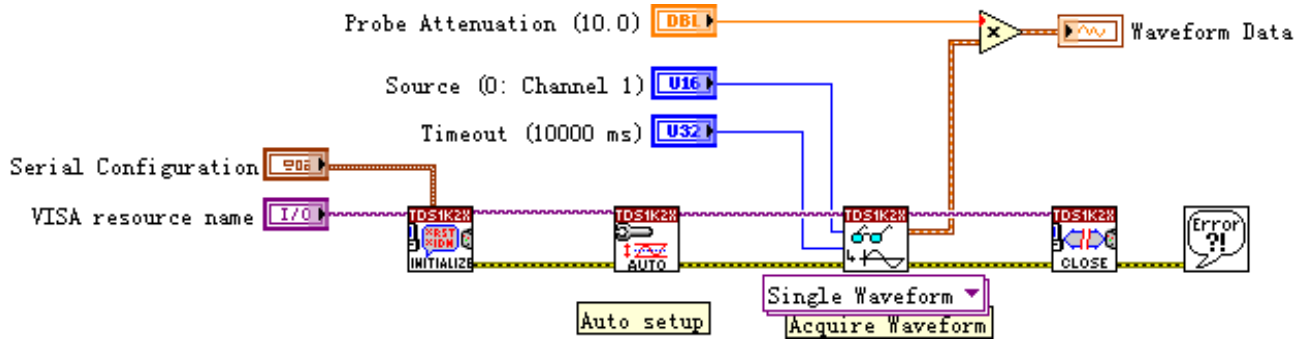

Figure2 A block diagram of data acquisition via serial port

We can have the further analysis and processing with the acquired data. For example, a sine input signal that impressed with a high frequency signal is processed with a Butterworth low-pass filter in LabVIEW program. As a result, the sine signal is recovered. And at the same time, the system can analyze the input and output signals in both the time-domain and the frequency-domain. The front panel of the simulation system is illustrated in Figure 3. The user can have a further analysis by the corresponding parameter configure and icons. The block diagram of the simulation system is illustrated in Figure 4.

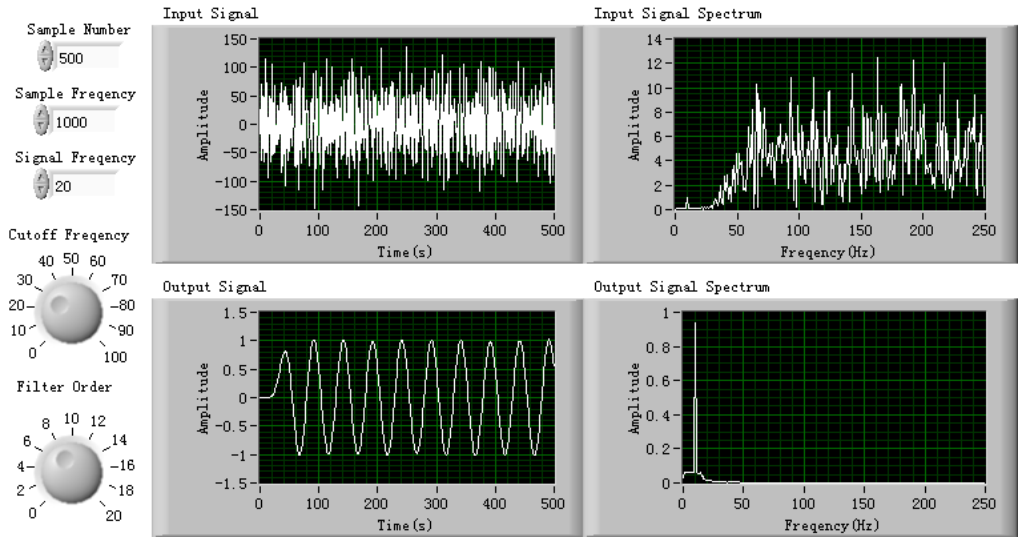

Figure 3 The front panel of the simulation system

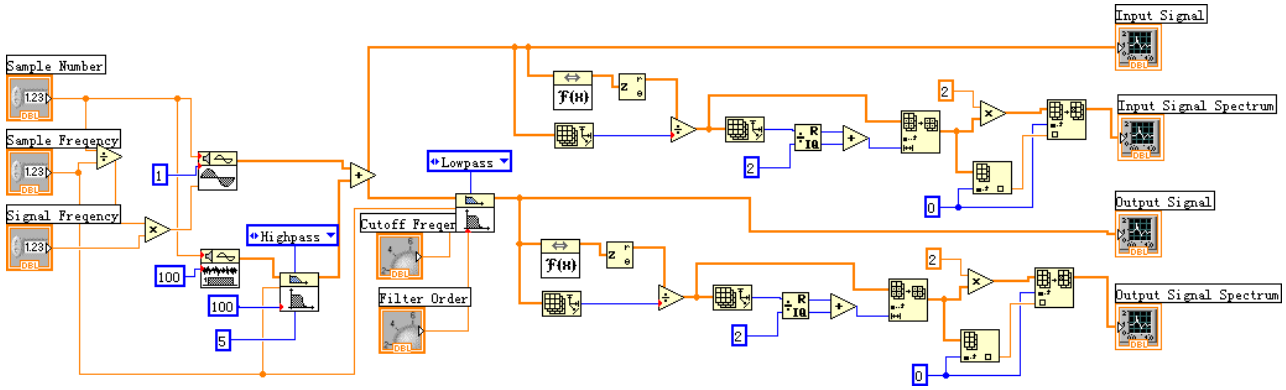

Figure 4 The block diagram of the simulation system

4. CONCLUSIONS

With the rapid development of PCs, Virtual Instrument will be applied in all kinds of measurement areas. Especially in seismographic observation, the users can acquire and analyze the seismographic vibration signals accurately. As a result, the seismographic observation will be realized more effectively. On the other hand, the systems used VI technology have other advantages, such as lower cost, shorter development period and its portability. It is can be seen that VI technology will be used widely in seismographic observation.

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