Research On The Dab Displacement And Rang Force

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Abstract. The horn is one of the essential parts of the car, the main function is to alert pedestrians and surrounding vehicles around the vehicle, to protect the safety of the pedestrian and vehicles. In the paper, the pulse commands to control the servomotor drive and limit of the limit switches to control both synergies smooth movement and safe operation of the force transducer, to achieve the car steering wheel by range force and displacement data are continuously collected. At the same time, the Bessel filter based on virtual instrument software is used to process the data further, and the waveform of the sound force and the displacement is displayed by the oscilloscope. Experimental studies have shown that the system test precision, high stability, reliability, it can automatically complete rang force and displacement detection.

Introduction

With the rapid development of China's economy, quality of life significantly improved and consumption capacity increase. Vehicle consumption view has entered ordinary families, family car ownership rising rapidly[1]. Horn is a sound signaling device of the car, in the process of moving the car, the driver is need to send out necessary audible signal according to requirements and rules which is to warn pedestrians or other vehicles to ensure traffic safety, also use for remind pedestrian and transmitting signals. Its performance directly affects the safety and control of traffic noise pollution.

Since China compulsory certification system for vehicles and parts, relevant national detection and identification agencies urgently need the appropriate test equipment and devices, motor vehicles and parts manufacturing enterprises also urgent need for the relevant product performance and quality control tests equipment. For automotive manufacturers, the testing equipment can quickly and accurately test the horn rang size of the force and displacement generated in the process of horn rang , which provides the necessary advanced detection instrument also improve and enhance the manufacturing process for business analysis.However, the user operability, precision, stability, reliability and degree of automation and the automotive industry and automotive electronics technology development still lags far behind. Reflected in lack of system integration equipment system, you need to manually adjust the test conditions, test data cannot be recorded and real-time processing; lack of capacity or data analysis, affect test accuracy. Therefore, it is a serious problem to solve to develop a fast, accurate, automated and integrated test platform for horn rang the size of the force and displacement of the test.In this paper, the servomotor drive, by emitting pulses command the servomotor speed is controlled to achieve the downward movement of force transducer vertical distance control through virtual instrument graphical programming language, the software interface is beautiful, easy to operate. The system uses the PCI bus IPC as the host computer, through an internal PCI card to plug some load switching, display means control, data acquisition and processing and generate excel reports and other work, the entire automated test process realize.

The Composition of Detection Device

The overall design of the test device, mainly by the two major components of software and hardware. The hardware consists of servomotors, industrial computers, ball screw, force transducer,

displacement sensors, servo drives and other devices composed.LabVIEW virtual instrument software, graphical editing G programming language, the program is produced in block diagram form, which greatly simplifies the preparation of the program, and to facilitate the observation.Using LabVIEW Bessel filter of the Digital Filter and waveform monitor, the desired operational compiled program and data displayed in real time by the software.The system's work flow:With force transducer and displacement sensors first convert the signal into a voltage signal, via the signal conditioning circuit, using Bessel filter to signal further filtering, and then by the data acquisition and transmission module for A / D conversion, and then through the serial port computer communications.Application of LabVIEW virtual instrument development tools to write software, to achieve signal acquisition display, storage and analysis.Finally, using LabVIEW virtual instrument designed Excel report generation module, the collected data is recorded in real time and save to achieve a whole automated detection system.The signal acquisition system block diagram shown in Figure 1.

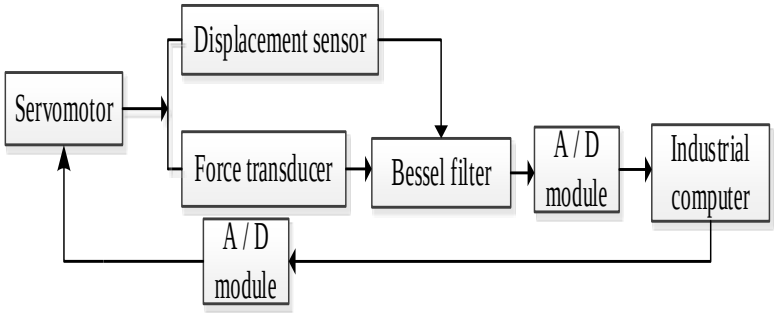

Figure 1 The signal acquisition system block diagram

Detection of Structural Design Principle

Servomotor Control Principle. Using the servomotor with the force transducer to test the sound pressure of the car steering wheel , the whole process in order to keep continuous stability data collection, therefore, the servomotor speed control is essential.

Position resolution (each pulse stroke) depends on the servomotor stroke per revolution ΔS and encoder feedback pulse number P_t, represented by the equation (1). The feedback number of pulses depends on servomotor series.

$$\Delta\rho = \frac{\Delta S}{P_t} \tag{1}$$

Where $\Delta\rho$ is each pulse stroke [mm/pulse]; ΔS is servomotor stroke per revolution [mm/rev]; P_t is feedback pulse number [pulse/rev].

Formula (1), when the drive system and encoder determines $\Delta\rho$ the control system to a fixed value, but each stroke of command pulse can be set according to need to use the parameter[2].As shown in Figure 2.

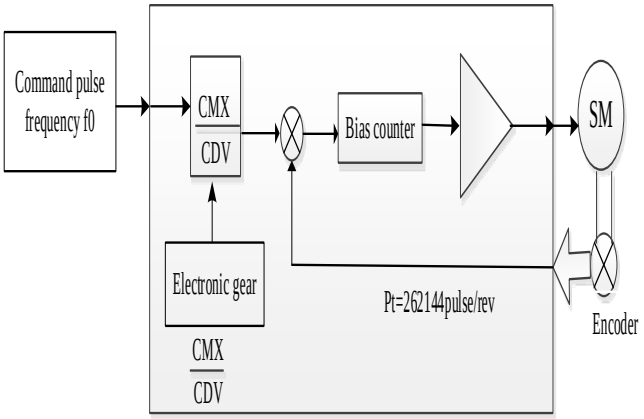

Figure 2 command pulse stroke control chart

$$\Delta\rho_0 = \frac{P_t}{\Delta S}\cdot\frac{CMX}{CDV} = \Delta\rho\cdot\frac{CMX}{CDV} \tag{2}$$

Where $\Delta\rho_0$ is the feed rate of each command pulse in the Position control mode; *CMX* is the electronic gear (command pulse multiplier numerator); *CDV* is electronic gear (command pulse multiplier denominator).

When the servomotor is started, at the beginning of acceleration and deceleration, due to the delay of the control system may cause a delay of a servomotor torque.Nevertheless, in order to simplify the calculation, it is assumed, t_{psa} and t_{psd} during the use of constant acceleration and deceleration torque.*TLH* represents the torque applied during the servo motor is stopped.Especially used in vertical movement during the stop of big torque, must be fully considered[3].During the vertical drive,the unbalanced torque will become T_{LH}.The relationship shown in Figure 3:

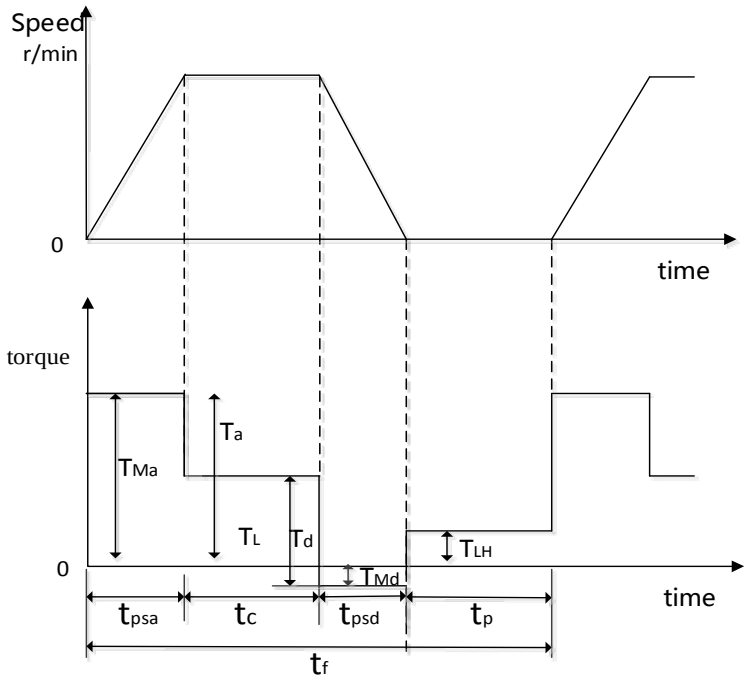

Figure 3 servo motor speed and torque variation graph

Where T_{Ma} is accelerate the necessary servomotor torque; T_{Md} is deceleration the necessary servomotor torque; T_a is acceleration torque; T_d is deceleration torque; T_L is load torque converted to the equivalent value of the servo motor shaft; T_{LH} is unbalance torque; T_p is position control time constant; t_f is a cycle; t_c is servomotor uniform motion a week.

Figure 3 have the following formula:

$$T_{rms} = \sqrt{\frac{T^2_{Ma}\cdot t_{psa} + T^2_{L}\cdot t_c + T^2_{Md}\cdot t_{psd} + T^2_{LH}\cdot t_p}{t_f}} \tag{3}$$

Where t_{ms} is the continuous effective load torque is converted to the equivalent value of the servomotor shaft.

With the above relation, each stroke of the command pulse can be set to an integer value.Therefore, by providing instruction for each pulse of the trip, you can control the force transducer runs vertically downward velocity to achieve force transducer and displacement sensor for continuous and stable data collection.

Application of Bessel Filter. Data acquisition and digital filtering is an important branch of digital signal processing and digital filtering algorithm is a very important part of the whole system, which directly determines the data acquisition system speed and accuracy [4].

Bessel filters having a maximally flat group delay of the linear filter.Bessel filter depicted as almost across the entire pass band constant group delay, and thus it maintains the signal waveform to be filtered in the pass band[5].Bessel filters have maximally flat amplitude and phase response,it can use to reduce all the inherent nonlinear phase distortion of the IIR filters.Bessel filter transition time in the whole pass band are very stable, so it's a frequency curve does not hold ringing.Therefore, in order to collect rang force and displacement data further optimized, so choose Bessel filter for data processing.

Results and Analysis of Car Horns rang Force and Displacement Detection

Currently, NI has introduced a graphical programming language LabVIEW, it uses icons, wiring and block diagrams, etc. instead of traditional programming code that can visually observe the program flow [6]. we can easily create a variety of virtual instruments with it, it is widely applied to various fields of communication, aerospace, industrial automation and automotive industries, not only because it's written because the interface beautiful, powerful, and can achieve data acquisition, analysis, processing and display centralized operation.

Data Processing. The experiment is to collect and use by influential force sensor displacement sensor to collect displacement by the pressure sensor, and then through the acquisition card, the IPC data processing, and finally converted to force values rang through the oscilloscope, visually show rang changes in waveform force, and visually analyzed the value and displacement by influential relationship.Figure 4 is a waveform diagram of raw data:

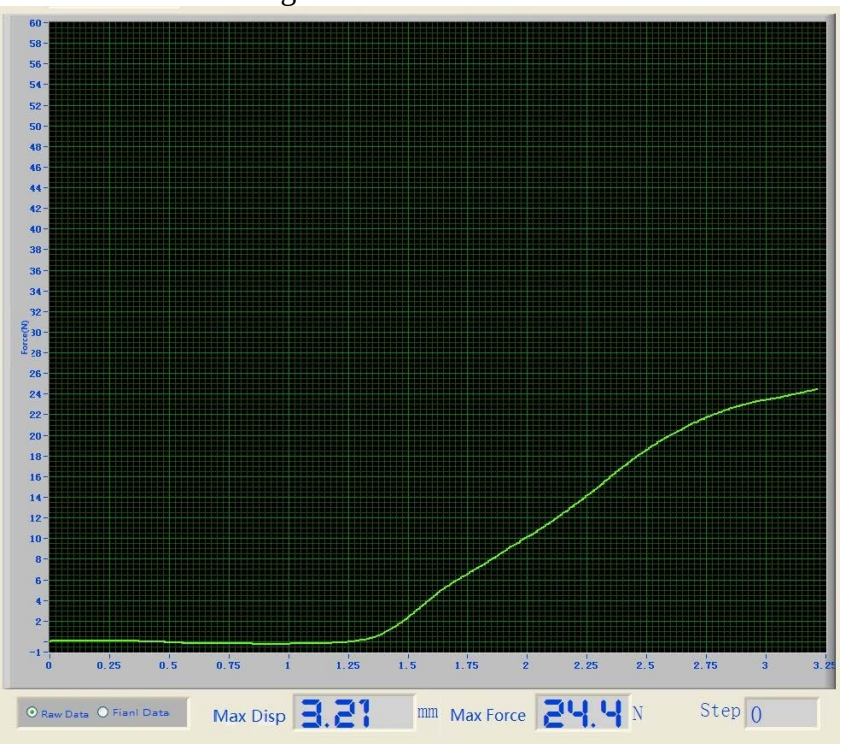

Figure 4 original data waveform figure

In the experiment, since the speaker button on the steering wheel of the car keys on the keypad plate spring a small gap, causing the load cell when the steering wheel horn button plate contacts, in order to complete with steering wheel keypad spring contact, need to through a period of air travel, after repeated experiments and the original acquisition data processing, the measured displacement of the segment of air travel is 1.40mm, that is, only when the load cell decline 1.40mm, force and displacement to be effective at the moment. After processing the data waveform diagram in Figure 5:

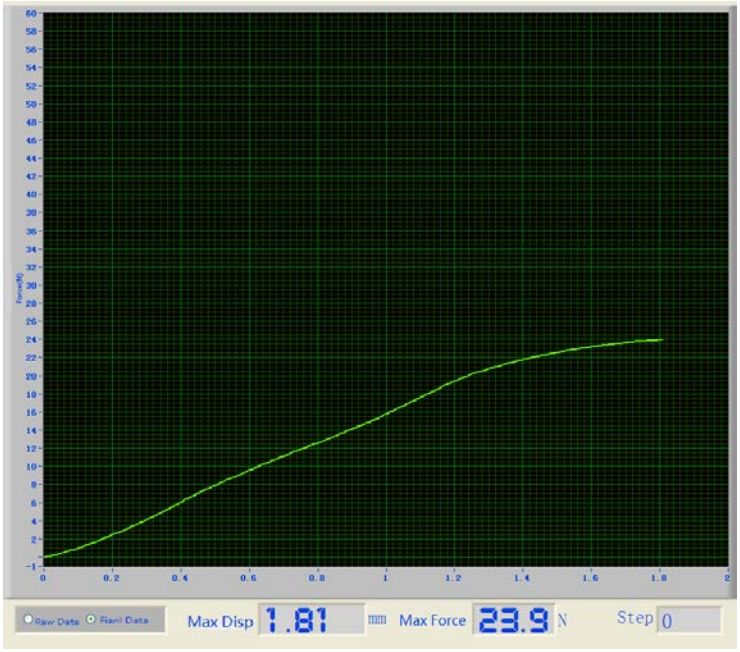

Figure 5 waveform data processing

Car Steering Wheel Fang Force and Effective Displacement Test Results Analysis. After several of the steering wheel 3 o'clock, 6 o'clock, 9 o'clock direction detection, generate Excel Table 1, Table 1 have shown the steering wheel by influential maximum force is 23.9N, effective displacement is 1.81 mm in rang process produces. With this experimental data, not only for cars overall operating system to a more intelligent, humane and provides a theoretical reference driving safety, but also improving the life of the steering wheel used.when a person driving a car, honking horn steering wheel keypad simply need exert 23.9N, no need to apply extra force to avoid the steering wheel horn keypad damage.

Conclusion

Driven the load cell smooth movement by the control servomotor drives , while using the limit switches to control the load cell vertically downward stroke to realize the force and displacement data collection. using Bessel filter to process the raw signal, using virtual Instruments LabVIEW graphical programming language in the oscilloscope, visual image shows the pressure variation waveform with displacement.The testing equipment’s user operability , high precision, stability, reliability and the degree of automation, the entire test automatically, reduces test time and greatly improve work efficiency, and long life.

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