

Research on Measurement Method of Ultrasonic Flowmeter

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Abstract

Starting with ultrasonic flowmeter, this paper focuses on the development and application prospect of ultrasonic flowmeter. From the current research results, ultrasonic flowmeter can have a variety of detection methods, among which the most popular methods are propagation velocity difference method, Doppler method and correlation method. From the current market point of view, the research on time difference method of propagation velocity method is profound. By comparing the above methods, this paper analyzes the applicability of several methods.

Keywords

Ultrasonic Flow; Time Difference Method; Doppler Method; Correlation Method.

1. Introduction

The development history of ultrasonic volume has been more than ten years, and it has been developing rapidly since its birth. With the development of integrated circuits in 1970s, the requirement of time measurement accuracy is higher and higher. The appearance of high-performance and stable flowmeter technology ensures the accuracy of ultrasonic flowmeter. At the same time, in order to reduce the influence of sound velocity on the accuracy of ultrasonic flowmeter, it has become a development trend to use frequency difference method to measure ultrasonic flowmeter. The measurement speed of frequency difference method is obviously faster and the propagation distance is far away. Under this trend, people gradually like it. Because it weakens the disguised influence of sound velocity on the measurement results, its measurement results are highly praised by people. Because there are many methods of ultrasonic measurement, the frequency difference method has good measurement applicability. The main principle of the beam shift method in ultrasonic measurement is that when ultrasonic wave propagates in the fluid, its beam will inevitably shift. According to the effective measurement of the shift, this method weakens the wavelength sensitivity in the propagation process. It can effectively control the outflow of pipe diameter with larger flow. Compared with the measurement results of the above methods, Doppler method has obvious deviation. Doppler method mainly measures the frequency shift process of scatterers in fluid effectively, and this method can effectively filter the impure fluid properly. Correlation rules mainly rely on the support of related technologies to test and detect correlation. However, compared with other methods, there are obvious defects. If the measured circuit is relatively complex at this time, it will cost more. However, this method has good adaptability and is widely used in high-tech fields.

With the rapid development of intelligent technology in 1990s, the development mode of ultrasonic flowmeter has been completely changed, and the maturity of single chip microcomputer technology has promoted the rapid development of ultrasonic flowmeter. As a central processing system, single-chip microcomputer can not only process complex data with high quality, but also effectively avoid errors in the measurement process. The error rate of system operation can be effectively reduced, and the repair of parameters and data can greatly improve the user experience. The innovation of single chip microcomputer technology plays an

important role in promoting the development of ultrasonic flowmeter, which makes the measurement method of ultrasonic flowmeter widely used in industrial fields.

2. Research Status of Ultrasonic Flow Technology

In recent years, with the rapid development of signal technology, the technology of microprocessor is becoming more and more perfect. The development of microprocessor not only promotes the progress of material technology, but also promotes the progress of fluid mechanics and the change of flow technology.

The development of ultrasonic flow measurement has been precipitated for many years. From the current research and application results, the ultrasonic flow measurement technology at home and abroad is mainly aimed at accurately measuring the information or substances flowing in the fluid. Ultrasonic flowmeter is mainly composed of ultrasonic flowmeter, electronic circuit and ultrasonic transducer for flow display and accumulation. The ultrasonic energy is converted and guided by flow measurement. The ultrasonic signal is induced, and then the signal is amplified by circuit induction to obtain the flow signal, so that it is convenient to calculate the signal and make the flow detection easier[1].

Controlotron Company of the United States used signal processor technology to deeply measure the flowmeter, such as synchronous adjustment technology and FFT technology, and mainly used DSP as the technical core for processing, which not only accelerated the propagation speed of ultrasonic flowmeter, but also facilitated the processing of some complicated process algorithms, such as DDF3088 of Ploysonics Company, which promoted the development of Doppler flowmeter of the company. Mainly relying on filtering and digital analysis technology, filtering can be automatically identified. The rapid development of liquid crystal technology makes the development of Doppler technology turn. When measuring flowmeter, using time difference method can be more convenient to calculate and reduce the influence of temperature difference on speed. Controlotron Company has effectively combined time difference method with Doppler method through long-term practice. The practical skills of the product are improved. However, the cost of this product is too high, which makes it impossible to popularize the technology in China[2].

From the present research results, the overall price of ultrasonic measurement is cheap. Accurate measurement of pipeline fluid not only helps to realize the fluid measurement technology, but also promotes the development of analog signal technology by using the time difference method. However, from the current research results, the operation of single-chip microcomputer is limited by time, the algorithm is relatively simple, and it lacks advanced technology. Through digital measurement, the flow velocity is scientifically calculated, and there is a big difference in time temperature difference, which leads to a big error in measurement. For example, the ultrasonic series flowmeter produced by Beijing Zhongneng is the leading flowmeter in China, with a new type of microwave controller. After a long period of practice, And the progress of DSP and circuit technology has effectively promoted the maturity of analog signal technology. The ultrasonic flowmeter with DSP as the main core gradually adapts to the development of the times, replacing the single-chip fluid meter which has been popular for decades in the past. Using signals to improve the accuracy of products is favored, and the accuracy of the system is improved by interpolation[3]. Therefore, the development of domestic meters has gradually reached the international advanced level.

3. Analysis of Ultrasonic Flowmeter

3.1. Classification of Ultrasonic Flowmeter

Ultrasonic flow measurement is widely used. When ultrasonic waves pass through the fluid by reflection, there will be differences for different carrier flow rates. Ultrasonic flowmeter is more sensitive to signals, so it will respond quickly. Different methods will cause obvious deviation of measurement results. Therefore, different setting methods are required to effectively detect the propagation process. According to this, ultrasonic flow detection plans can be divided into several categories, such as time difference method, phase difference method, frequency difference method, Doppler method and correlation method[4].

3.2. Propagation Speed Difference Method

Because of the downstream and countercurrent of water velocity, ultrasonic waves will have different performances when propagating in different situations. Usually, the velocity difference and fluid velocity are used to establish the variable relationship. Due to the different physical quantities, the propagation velocity difference method is divided into different categories, which are generally divided into phase difference method and direct frequency difference method. Time difference method is used to measure the downstream and countercurrent of ultrasonic velocity process, which is suitable for the measurement of large pipe diameter and mouth. However, this measurement method is easily affected by temperature, and its variation fluctuates greatly. Because the change of temperature in fluid usually affects the measurement threshold, it will have important changes on the measurement accuracy, so this influence must not be ignored. The frequency difference method is obviously different in the measurement process, focusing on measuring the flow rate of the cycle frequency difference in the closed cycle system. Compared with the time difference method, the frequency difference method has obviously higher accuracy and is not easily affected by temperature, so it is valued by enterprises. However, this technical method is still easily affected by the environment, and there are big defects. The phase difference method is mainly to effectively convert the time difference. This method effectively reduces the time difference in measurement and the error in the measurement process, and the change of temperature has a great influence on the measurement results[5].

3.3. Doppler Method

Doppler method is widely used in medical monitoring, and its main principle is to use acoustics to determine the flow rate of fluid according to the frequency spectrum. Similarly, Doppler technology is also based on this principle in the field of industrial measurement. Usually, it is necessary to measure the quicksand and large flow of particles in river water. Doppler method can define the sediment content according to different flow rates. However, due to the disturbance of the liquid in the flow rate, such as bubbles or suspended particles, when the medium flow is unstable, the reflected ultrasonic waves will have a certain frequency shift, which will lead to the lengthening of the radiation arc, thus directly affecting the pipeline flow rate or flow rate. The development of Doppler measurement technology has been quite mature so far, From the current research results, it can not only measure suspended particles and impure liquid, but also be easier to measure pure fluid[6]. For example, the appearance of Bosch DS Doppler flowmeter is based on the measurement of pure fluid.

3.4. Correlation Method

Correlation method is different from Doppler method and time difference method, which mainly uses ultrasonic technology to transform the flow measurement into the measurement of time interval. Because of the great difference of flow velocity in fluid, effective correlation of time and distance between beams can be achieved according to the theory of ultrasonic

correlation knowledge[6]. Measure the time interval between beams, The sound velocity is reduced and the abortion of other fluids has a great influence on the measured value. Developed countries attach great importance to the application of correlation method in ultrasonic flowmeter, and accelerate the investment in this field, especially in Europe and America.

4. Conclusion

There are obvious advantages and disadvantages in the measurement and application of ultrasonic flowmeter methods such as propagation method, time difference method, and correlation method in different fluids. Therefore, suitable measurement methods should be selected in the measurement field, so as to better apply to the ultrasonic measurement field.

References

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