Eng Int Syst (2022) 1: 67–76

Engineering
Intelligent Systems

Synchronous Signal Transmission System of Wireless Sensor Network Array in Big Data Environment

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In order to improve the synchronous transmission capability of wireless sensor network array signals, a synchronous transmission method based on a large data environment, together with an adaptive parameter adjustment, is proposed. In this paper, we build a receiving model for wireless sensor network array signals, filter the wireless sensor network array signal by adopting a gain amplification and output steady-state adjustment method, perform gain amplification and characteristic separation of the wireless sensor network array signal by adopting a high-resolution signal fusion filtering detection technology, extract spectral characteristic quantities of the wireless sensor network array signal, and perform output integration of the wireless sensor network array signals by applying an autocorrelation beam forming method. The synchronous transmission control of wireless sensor network array signals is achieved, gain adjustable amplification processing is carried out according to the synchronous transmission control output result of wireless sensor network array signals, gain adjustable amplifiers are constructed, and the optimization of synchronous transmission of wireless sensor network array signals is achieved. The simulation results show that this method improves the output accuracy, characteristic resolution and synchronous transmission of signal-to-noise ratio of wireless sensor network array signal.

Keywords: big data environment, wireless sensor network, array signal, synchronous transmission

1. INTRODUCTION

In the design process of the wireless sensor network array signal synchronous transmission system, a detection model needs to be constructed, and the amplification processing of the wireless sensor network array signal is carried out in combination with a signal output stability test method, so that the detection and identification capability of the signal is improved (Mohan and Govardhan, 2013). During synchronous transmission, the wireless sensor network array signal is influenced by environmental interferences and noise factors. As a result, the accuracy of synchronous transmission is not high. Hence, it is necessary to carry out amplification processing of wireless sensor network array signals (Kimmett et al., 2015). Combined with signal filtering and detection methods, gain amplification control of wireless sensor network array signals is carried out to improve the signal output. The related research on synchronous transmission and amplification technology of wireless sensor network array signals has attracted great attention (Zhao and Huang, 2018).

Passive target location in wireless sensor array networks has the similar characteristics of collaborative information processing in traditional sensor networks, and is constrained by resources, that is, energy constraints and the limited computing and communication capacity of a single node. However, the passive target location of a wireless sensor array network has several advantages over the traditional sensor network location methods: high precision, strong anti-interference, wide range of target monitoring, among others. Research developments have enabled the passive target location of wireless sensor array networks to be applied successfully in military and civil fields. In order to meet current needs, an important development direction of array

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technology is the multi-array join, which can improve the monitoring effect by means of data fusion. The multi-array join system can monitor vehicles, helicopters, gun positions and personnel in the target area. “The traditional multi array system uses wired interconnection for data communication, that is to say, each array uploads the collected signals to the central processing system through wired way for signal processing”. The development of wireless sensor networks gives array technology a new research direction. Initially, array technology was used by the military, roughly divided into underwater and land array technology. During the first World War, French scientists designed two circular arrays with a certain distance between them. Each circular array consisted of six transmitters. “The array can determine the direction of the source through the method of human ear monitoring, so as to detect the enemy aircraft. During the Second World War, detection and investigation made great contributions in artillery operations.” Later, with the emergence of radar detection technology, at one time, the land array was neglected. But the radar faced three threats: electronic interference, anti-radiation missiles, and low altitude penetration.

Compared with other electronic detection technologies, the array technology has the following advantages: First, the array technology belongs to passive detection, has strong concealment, is not easy to be found by the enemy’s electronic reconnaissance equipment, and is not easy to be interfered; Second, waves can bypass mountains and rocks. Through obstacles such as jungle, array technology can effectively search for targets in low altitude or ground radar detection blind areas. These advantages have attracted much interest in array technology. Since the 1980s, the breakthrough development of science and technology given array technology broader application prospects in the military. For example, a “typical representative of underwater array technology is Na”, an underwater positioning system, which is anti-helicopter and anti-tank. The main idea of this system is to form a relative measurement reference through the baseline, measuring the distance from each water signal propagation delay indirect measurement source to the baseline hydrophone “underwater array technology can be used for environmental monitoring, resource exploration, seabed exploration, disaster prevention, marine geological survey and many other scene array networks have been widely concerned by many research institutions at home and abroad.” The mobile node prototype in the pursuit test designed by the Department of Electronic Engineering, University of California, Berkeley, was adopted. It uses micro array technology, three kinds of physical parameters (sound, vibration and image) for collaborative processing, and integrates wireless network communication, environment and avoidance mapping design. Strategy planning and response decision-making technology can achieve dynamic tracking ranging from multiple mobile arrays to multiple active target sources.

The monitoring of wireless sensor network array signals is based on signal model construction and filtering analysis. A characteristic decomposition model of wireless sensor network array signals is established. The detection and identification of wireless sensor network array signals are carried out by integrating the characteristic decomposition method. An intelligent wireless sensor network array signal synchronous transmission system is designed (Li et al., 2018). The signal intelligent detection is carried out by integrating the wireless sensor network array signal processing technology. Using big data environment and adaptive parameter adjustment, this paper proposes a wireless sensor network array signal synchronous transmission method.In wireless sensor network, the array signal receiving model is established; the array signal of wireless sensor network is filtered; the high-resolution signal fusion filtering method is used to gain and amplify the array signal; the spectrum feature of the signal is extracted through the feature separation detection technology (Fan et al., 2018); The autocorrelation beamforming method is used to perform the output integration of the signal, and the synchronous transmission control of the wireless sensor network array signal is realized. Finally, according to the output results, a gain adjustable amplifier is constructed to realize the synchronous transmission optimization of wireless sensor network array signal. Finally, the simulation test analysis shows the superior performance of the method in improving the synchronous transmission capability of wireless sensor network array signals (Hesham et al., 2019; Sheeza et al., 2019; Joanna, 2019).

2. BASIC DEFINITIONS

In order to achieve the intelligent detection and construction of pronunciation errors of the wireless sensor network array signal synchronous transmission system, a signal processing method is adopted to extract characteristics and identify information in the signals, firstly, a synchronous transmission model needs to be constructed, and then a high-order statistical characteristic quantity map of the wireless sensor network array signal is extracted (Gu et al., 2012).

By measuring the distance or orientation between adjacent nodes, the distance based positioning mechanism is used for positioning. This process has three stages:

1. Ranging, positioning and correction: The unknown node first measures the distance or orientation from the neighbor node or beacon node directly or indirectly. When calculating the distance from the neighbor beacon node, the straight-line distance from the unknown node to the beacon node can be calculated, or the hop distance between the two can be used as the approximation of the straight-line distance.

2. In the ranging mechanism based on the time difference of arrival TDoA, the transmitter node simultaneously transmits two different propagation rates of signals. The receiver nodes calculate the distance between the two nodes according to the time difference between the two signals and the known propagation speed of the two signals, such as simultaneous interpreting the radio frequency signal and the acoustic (or ultrasonic) signal at the same time.

3. Because the propagation rate of the radio frequency signal in the air is much higher than that of the acoustic

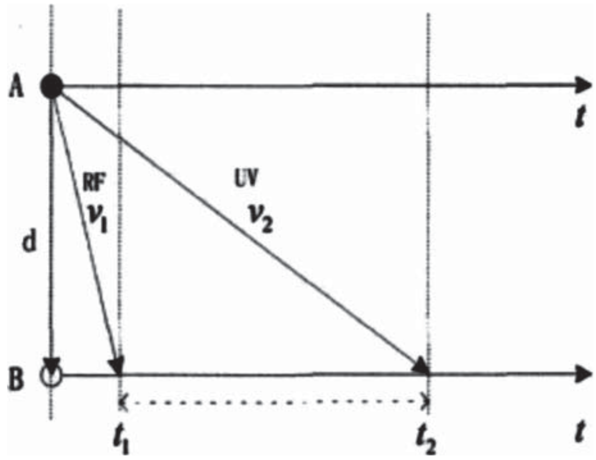

Figure 1 Schematic diagram of positioning operation principle.

signal, it can be assumed that the transmission and reception of radio frequency signal are synchronous, which solves the problem of time synchronization between nodes. By using the difference between the arrival time of two kinds of signals, the transmission time of acoustic signal between two nodes can be estimated. The distance between nodes can be measured by using the propagation rate of acoustic wave in the air. This ranging method effectively reduces the requirement of time synchronization between nodes and has high accuracy. The positioning principle is shown in Figure 1.

In the distance measurement based on the received signal strength indication RSSI, the transmitting signal strength of the transmitting node is known, and the receiving node calculates the transmission loss of the signal according to the received signal strength. The transmission loss is transformed into distance by using the theoretical and empirical model, and then the position of the node is calculated using the existing calculation method. "This technology mainly uses the radio frequency signal, without additional hardware and data exchange." In terms of low cost and low power, although distance-based positioning can achieve accurate positioning, it often requires complex hardware for wireless sensor nodes. In consideration of the cost of hardware and energy consumption, researchers have proposed a distance-independent positioning technology. Distance-independent positioning technology does not need to measure the absolute distance or orientation between nodes, which reduces the requirements for hardware configuration of nodes. At present, there are two kinds of distance-independent positioning methods. One estimates the distance between nodes, and then uses the trilateral measurement method or the maximum likelihood estimation method to locate the nodes. This technology first calculates the time difference of the sound signal reaching the microphone at different positions, then uses this time difference to calculate the distance difference of the sound reaching the microphone at different positions, finally, the location of sound source is determined by geometric measurement. "Because each time difference uniquely corresponds to a bimodal, multiple microphone pairs can get multiple hyperbolas, and the intersection of these hyperbolas is the position recognition 65 of the sound source." The technology first estimates the delay of each microphone pair, and then on the basis of obtaining multiple time differences of arrival, through search, or by a suboptimal method. How to estimate the position of the sound source? This technology requires a small amount of calculation, has good real-time performance, and can be achieved at low cost. The positioning model is as follows.

The essence of the azimuth positioning technology is multi-sensor information fusion technology, which is widely used for navigation, tracking, and in other fields. This technology achieves positioning by solving the intersection point of the azimuth lines measured by each sensor to the target. Take the two-dimensional plane as an example. In the DOA estimation based on the acoustic array, only azimuth positioning is achieved, and the DOA of each array can be measured. Ideally, the azimuth lines represented by each DOA will intersect at one point. Theoretically, only two azimuth lines (i.e., two nodes) are needed to locate the target.

The nodes in the network are usually divided into two categories depending on whether they know their own information: beacon nodes and unknown nodes. Generally, the information of beacon nodes can be obtained through manual configuration or high-performance positioning devices. Unknown nodes estimate their own position with a certain number of beacon nodes. When beacon nodes are in a static state, their density must be kept at a certain level. In general, the cost of beacon nodes is much higher than that of common nodes. The greater the number of beacon nodes, the greater is the positioning accuracy. Beacon nodes are used only to assist node self-positioning during network initialization. After this, the beacon nodes lose their importance and function just like other nodes, which creates wastage,which also creates wastage. In addition, there can be irregular deployment of beacon nodes. Obstacles in the area will also cause large positioning errors. How to achieve high efficiency self-positioning at a lower cost is an issue. The work of international significance, using mobile beacons for acoustic array network self positioning can significantly improve the reuse rate of beacon nodes and effectively reduce the need for equipment or labor costs. Figure 3 is a schematic diagram of node distribution.

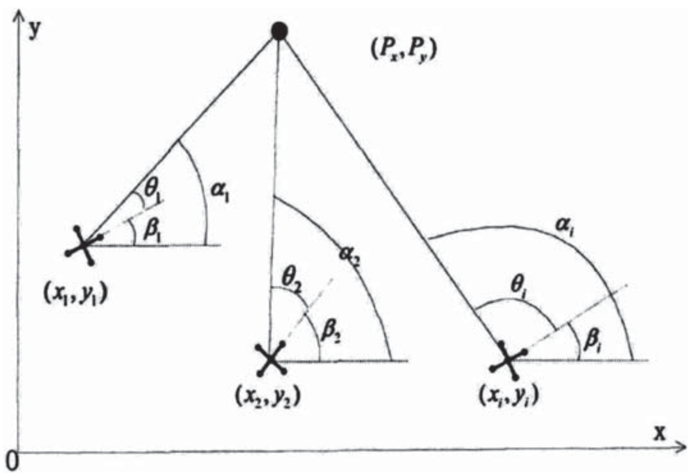

Figure 2 Bearing only positioning model based on DOA.

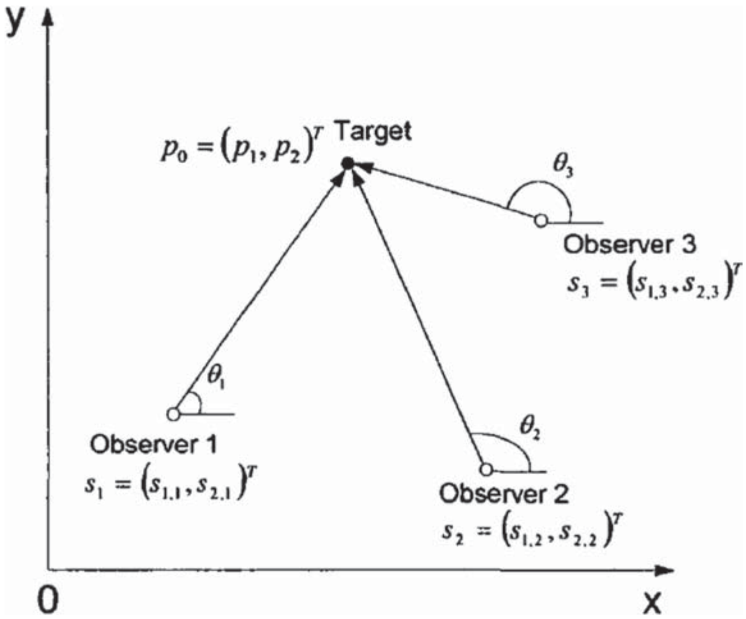

Figure 3 Schematic diagram of multi-point positioning of a target.

Firstly, the unknown node roughly estimates its own position, then calculates the distance from the beacon node, estimates the delay, and then corrects the location information of the beacon node to relocate. The process is as follows:

1) When moving, beacon nodes broadcast their position, speed and corresponding time in real time.
2) The unknown node uses BML to roughly estimate its position according to the current received position, speed and the estimated DOA.
3) According to the rough position value obtained in 2), the distance between an unknown node and the beacon node is estimated, and then the propagation delay of the acoustic signal is obtained.
4) According to the estimated propagation delay of the acoustic signal, the bit of the beacon node at the corresponding time is extracted by fallback. Combining the location information with DOA detected by unknown nodes, BML is used for self-localization.

The special feature of array network self-localization is that the information to be estimated is not only the location information of nodes, but also the orientation information. According to the situation of unknown nodes, there are three possible working scenarios for the self-localization mechanism of acoustic array nodes based on the target sound source:

1) the location of the unknown node is unknown and the orientation is known;
2) the position of the unknown node is known and the direction is unknown;
3) the location and orientation information of unknown nodes are unknown.

As the number of normal nodes increases, the errors of position and orientation angle become smaller and smaller. This is mainly because the position information of pseudo beacon nodes becomes more accurate, so the self-positioning

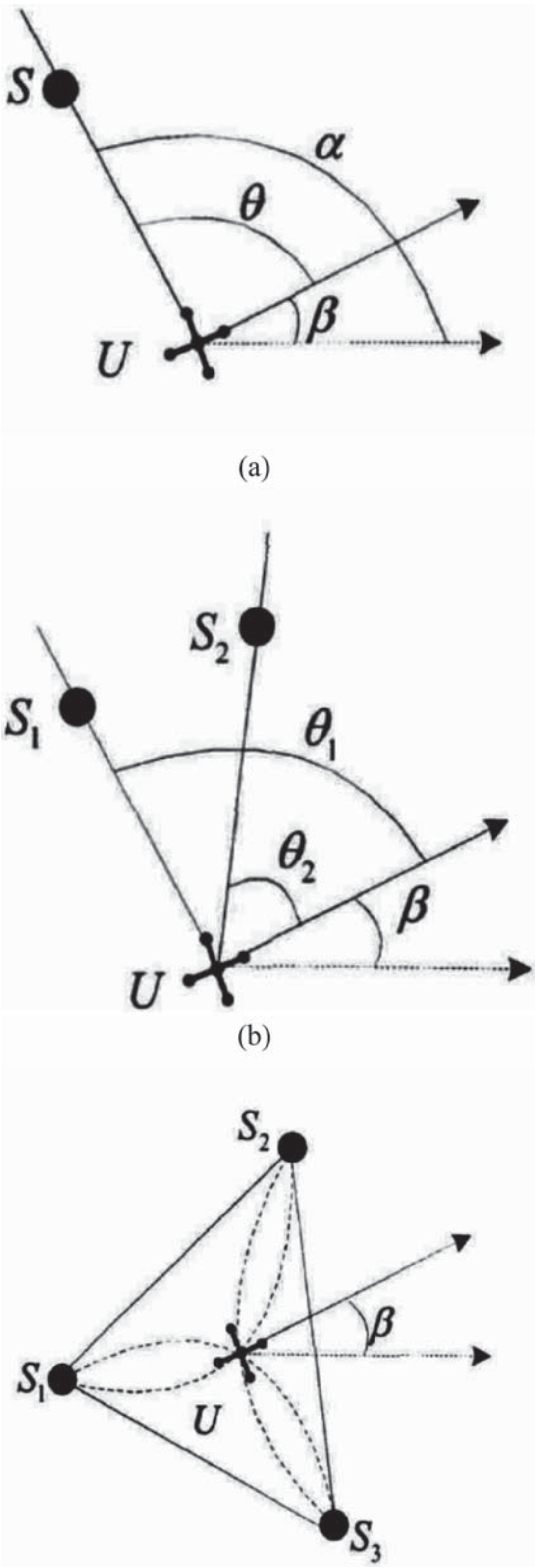

Figure 4 Self positioning diagram of target source.

effect of unknown nodes is better. The self- positioning mechanism regards the target sound source as a pseudo beacon, and its position accuracy will directly affect the self-positioning effect.

Through the Mel-frequency cepstral coefficients (MFCC) coefficient feature analysis method, the fuzzy clustering and feature analysis of wireless sensor network array signals are carried out, spectrum feature extraction of wireless sensor network array signals is sensed based on an inverted bimodal exponential model so that acquisition sensors of wireless sensor network array signals are uniformly distributed arrays, and spectrum distribution of wireless sensor network array signals is obtained in reference array elements, namely:

$$\nu(t,\theta) = \sum_{m=1}^{M} \omega_i^*(\theta)x_i(t) = \sum_{m=1}^{M} x_i^*(t)\omega_i(\theta) \quad (1)$$

In the formula, "*" represents a complex conjugate operator. The adaptive beam-forming method is applied to perform exponential fusion on the wireless sensor network array signals, and the frequency domain characteristic quantity of the output wireless sensor network array signals is obtained as follows:

$$\nu(t,\theta) = \omega^H(\theta)\chi(t) = \chi^H(t)\omega(\theta) \quad (2)$$

In the formula, "H" means complex conjugate transposition; $\chi(t)$ and $\omega(\theta)$ are instantaneous time domain signal components and weighting vectors of wireless sensor network array signals respectively, which can be expressed as:

$$\chi(t) = [x_1(t) \quad x_2(t) \quad \cdots \quad x_M(t)]^\tau \quad (3)$$

$$\omega(\theta) = [\omega_1(\theta) \quad \omega_2(\theta) \quad \cdots \quad \omega_M(\theta)]^T \quad (4)$$

Combining the suppression method of impulse noise, the time delay of wireless sensor network array signal acquisition is obtained as $\tau_0(\theta) = \frac{\Delta}{c}\sin\theta$, and the i-order wireless sensor network array signal components are spectrally separated (Guo et al., 2018; Ye et al., 2014; Bi et al., 2015), and the instantaneous power spectral density of the output wireless sensor network array signal is obtained as follows:

$$c_i(n) + \sum_{j=1}^{2p} \Phi_{ij}(n)c_i(n-j) = \sum_{k=1}^{2q} \Theta_{ik}(n)u_i(n-k) + u_i(n) \quad (5)$$

Combining adaptive filtering and blind source separation method, the characteristic decomposition of the wireless sensor network array signal is carried out, and the ambiguity detection output of the wireless sensor network array signal is obtained as follows:

$$\tau_m(\theta_i) = (m-1)\tau_0(\theta_i) = (m-1)\frac{\Delta}{c}\sin\theta_i \; (m = 1, 2, \cdots, M) \quad (6)$$

Here, $\tau_0(\theta_i) = \frac{\Delta}{c}\sin\theta_i$ represents the nonparametric probability density, c is the frequency spread, and the signal model of synchronous transmission of wireless sensor network array signals obtained by using a nonlinear detector is expressed as follows:

$$\begin{bmatrix} x_1(t) \\ x_2(t) \\ \vdots \\ x_M(t) \end{bmatrix} = \begin{bmatrix} \sum_{i=1}^{d} g_1(\theta_i)s_i(t) \\ \sum_{i=1}^{d} g_2(\theta_i)s_i(t - \frac{\Delta}{c}\sin\theta_i) \\ \vdots \\ \sum_{i=1}^{d} g_M(\theta_i)s_i(t-(M-1)\frac{\Delta}{c}\sin\theta_i) \end{bmatrix} + \begin{bmatrix} n_1(t) \\ n_2(t) \\ \vdots \\ n_M(t) \end{bmatrix} \quad (7)$$

Taking the above signal model as input, a wireless sensor network array signal receiving model is constructed, and a gain amplification and output steady-state adjustment method is applied to filter the wireless sensor network array signal (Ulukus et al., 2015).

With the help of the known equation of motion, the part and mean value that can be predicted are zero. The stochastic process with uncertain score extended Kalman filter is a mathematical method used to predict and filter the stochastic process, which can effectively process the statistical characteristics of time variance. Extended Kalman filter uses DOA observation model and motion model of moving sound source to predict the next sound source according to the estimated value of the previous time. The position estimation value is then modified by the observation value at this time. The prediction value is based on the motion model of the moving sound source, while the observation value introduces the actual random disturbance information. When the target is in motion, the acoustic array network obtains the accurate position information of the target through the filtering estimation algorithm based on the motion equation and the observation equation of the target. The basic idea is to combine prior knowledge with the new information. The target motion model predicts the target motion state at the current time. Therefore, the target tracking algorithm can effectively filter the environmental noise and the influence of unknown factors on the results by fusing the space and time data from all sensors in the network.

3. SIGNAL FILTERING AND GAIN ADJUSTABLE AMPLIFICATION PROCESSING

The high-resolution signal fusion filtering detection technology is adopted to amplify the gain and separate the characteristics of the wireless sensor network array signals. The filter depicted in Figure 5 is adopted to amplify the gain adjustably (Zhao et al., 2017).

Non-linear processing is performed on the received data in the gain adjustable amplifier (Yang et al., 2018). The bandwidth parameter of the wireless sensor network array signal matched with filtering detection is θ1(k), which is affected by the signal strength input of the wireless sensor network array signal.

The signal conditioning module is mainly based on the comparative analysis of the characteristics of sensor array signals. A unique signal conditioning circuit is designed for the different characteristics of acoustic, magnetic, vibration and infrared signals, and the conditioned sensor signals are output to the subsequent acquisition module. Because the signal to be measured is weak, the subsequent voltage signal is also small and the amplitude is uncertain. In order to make the amplitude of the signal moderate, the signal needs to be amplified. The general operational amplifier cannot directly amplify the weak signal, which must use the instrument amplifier. The instrument amplifier has high input impedance, low output impedance, strong resistance to common mode interference, low temperature drift, low

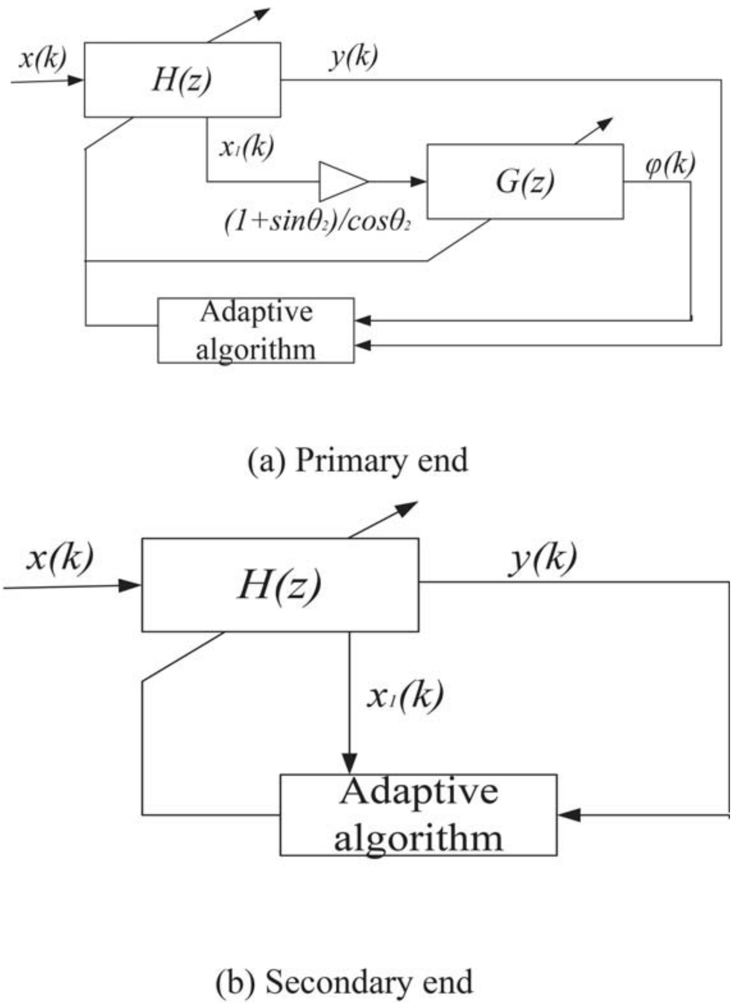

Figure 5 Gain adjustable amplifier.

offset voltage and high stability. In addition, before sampling, the signal must be processed with an anti-aliasing filter to remove high-frequency noise. The process of acoustic signal acquisition and transmission will inevitably encounter several interference factors. Therefore, it is necessary to pre-process the signal before further processing. This involves two steps: 1) convert the collected original data into a data format that can be easily processed by a computer; and 2) filter and smooth the collected signal to reduce the interference of noise with useful signals and improve the signal-to-noise ratio, thereby facilitating the subsequent processing. The detected target vector is $y(k)y^*(k)$, where "$*$" represents complex conjugate, and the filtering detection transfer function of the wireless sensor network array signal is:

$$\theta_1(k+1) = \theta_1(k) - \mu\,\mathrm{Re}[y(k)\varphi^*(k)] \tag{8}$$

where μ is the output order of the wireless sensor network array signal, $\varphi(k)$ is called the step size; $y(k)$ is the amplitude-frequency response of the output wireless sensor network array signal to the time domain deflection $\theta_1(k)$ of the matched filter detector (Fan and Li, 2018). Where there is a low signal-to-noise ratio, a multi-sample detection method is adopted to obtain a complex signal of the signal $s(t)$, and the gain adjustable amplification output function is obtained as follows:

$$H_B(z) = \frac{(1+\sin\theta_2)}{\cos\theta_2} \times \frac{\cos\theta_1(k)\cos\theta_2 z^{-1}}{1+\sin\theta_1(k)(1+\sin\theta_2)z^{-1}+\sin\theta_2 z^{-2}} G(z) \tag{9}$$

where

$$G(z) = \frac{1-\sin\theta_2}{2}\,\frac{1-z^{-2}}{1+\sin\theta_1(k)(1+\sin\theta_2)z^{-1}+\sin\theta_2 z^{-2}} \tag{10}$$

Gain amplification is carried out on the signal synchronous transmission output of the wireless sensor network array to improve the signal-to-noise ratio of the signal synchronous transmission output (Lyu et al., 2016).

4. SIGNAL SYNCHRONOUS TRANSMISSION OUTPUT

4.1 Signal Characteristic Decomposition

The output integration of wireless sensor network array signals is carried out by adopting an autocorrelation beam-forming method to achieve synchronous transmission control of wireless sensor network array signals. Real signals $s(t)$ are converted into complex signals $z(t)$, and the scale decomposition output of synchronous transmission of wireless sensor network array signals is obtained as follows:

$$\begin{bmatrix} x_1(t) \\ x_2(t) \\ \vdots \\ x_M(t) \end{bmatrix} = \begin{bmatrix} \sum_{i=1}^{d} s_i(t) \\ \sum_{i=1}^{d} s_i(t - \frac{\Delta}{c}\sin\theta_i) \\ \vdots \\ \sum_{i=1}^{d} s_i(t - (M-1)\frac{\Delta}{c}\sin\theta_i) \end{bmatrix} + \begin{bmatrix} n_1(t) \\ n_2(t) \\ \vdots \\ n_M(t) \end{bmatrix} \tag{11}$$

Given the number of interference factors, adaptive matched filter detection is carried out on the wireless sensor network array signal, so that the focusing capability of the output signal is improved. Matched filter processing is carried out on the wireless sensor network array signal, interference noise is removed, probability density characteristic estimation of the wireless sensor network array signal is carried out. The threshold of limiter type processing is obtained as follows:

$$s_i(t) = u_i(t)\cos[2\pi f_0 t + \varphi_i(t)](i = 1, 2, \cdots, d) \tag{12}$$

In the formula, sum is the positive frequency part of the frequency spectrum and phase $u_i(t)$ of the wireless sensor network array signal, respectively. By adopting the beam-adaptive focusing method, the transfer function of the wireless sensor network array signal is obtained with:

$$V(z) = \frac{\sin\theta_2 + \sin\theta_1(1+\sin\theta_2)z^{-1} + z^{-2}}{1 + \sin\theta_1(1+\sin\theta_2)z^{-1} + \sin\theta_2 z^{-2}} \tag{13}$$

For all ω, $|V(e^{j\omega})| = 1$, ensure that the positive frequency characteristic quantity of the wireless sensor network array signal is satisfied $V(e^{j\omega}) = e^{j\Phi(\omega)}$, and adopt a multi-scale wavelet decomposition method to carry out signal filtering and decomposition of characteristics, and adopt an efficiency function:

$$\tilde{s}_i(t) = u_i(t)\exp[j(2\pi f_0 t + \varphi_i(t))]\ (i = 1, 2, \cdots, d) \tag{14}$$

The correlation spectrum detection method is adopted to obtain the result of the decomposition of the WSN array signals, thus enabling the optimal detection of the signal (Huang and Liu, 2016; Cao and Wang, 2019).

4.2 Wireless Sensor Network Array Signal Synchronous Transmission Control Output and Gain Amplification

The output integration of the wireless sensor network array signals is carried out by adopting an autocorrelation beam-forming method to achieve synchronous transmission control of the wireless sensor network array signals, and the optimized limiting output is as follows:

$$\begin{aligned} \tilde{s}_i(t - \tau_m(\theta_i)) &= u_i(t - \tau_m(\theta_i))\exp[j(2\pi f_0(t - \tau_m(\theta_i)) \\ &\quad + \varphi_i(t - \tau_m(\theta_i)))] \\ &\approx u_i(t)\exp[j(2\pi f_0 t + \varphi_i(t))] \\ &\quad \times \exp(-j2\pi f_0 \tau_m(\theta_i)) \\ &= \tilde{s}_i(t)\exp(-j2\pi f_0\tau_m(\theta_i))\ (i = 1, 2, \cdots, d; \\ &\quad m = 1, 2, \cdots, M) \end{aligned} \tag{15}$$

Wherein

$$a(\theta_i) = [1\ \exp(-j2\pi f_0 \Delta\sin\theta_i/c)\ \cdots \\ \exp[-j(M-1)2\pi f_0\Delta\sin\theta_i/c]]^T \tag{16}$$

Using the efficiency function as a non-linear index parameter, the adjustable gain of wireless sensor network array signal $z(t)$ is obtained as follows:

$$A = [a(\theta_1)\ a(\theta_2)\ \cdots\ a(\theta_d)] \tag{17}$$

In the formula, the D-dimensional envelope feature vector $\tilde{S}(t)$ is:

$$\tilde{S}(t) = [\tilde{s}_1(t)\ \tilde{s}_2(t)\ \cdots\ \tilde{s}_d(t)]^T \tag{18}$$

The stability control of the wireless sensor network array signal is carried out by adopting a zeroer and a clipper group. The output is as follows:

$$H(\omega, t) = \mathrm{Re}\sum_{i=1}^{n} a_i(t)e^{j\int\omega_i(t)dt} \tag{19}$$

According to the output result of the wireless sensor network array signal synchronous transmission control, gain adjustable amplification processing is carried out to construct a gain adjustable amplifier in order to optimize the synchronous transmission of wireless sensor network array signal. The output is as follows:

$$x_k = \sum_{n=0}^{N-1} C_n \cdot e^{j2\pi kn/N}\ k = 0, 1, \cdots, N-1 \tag{20}$$

The detection error of the signal in impulse noise is $e(n)$, which can be obtained by simplifying the above formula:

$$x_k = \sum_{n=0}^{N/2-1} 2\left(a_n\cos\frac{2\pi kn}{N} - b_n\sin\frac{2\pi kn}{N}\right)\ k = 0, 1, \ldots N-1 \tag{21}$$

To sum up, combined with the gain adjustable amplification method, the synchronous transmission of wireless sensor network array signals is achieved.

5. SIMULATION TEST ANALYSIS

In order to verify the performance of the method in achieving the synchronous transmission of wireless sensor network array signals, a simulation experiment is carried out. The experiment is designed using Matlab 7. The sampling

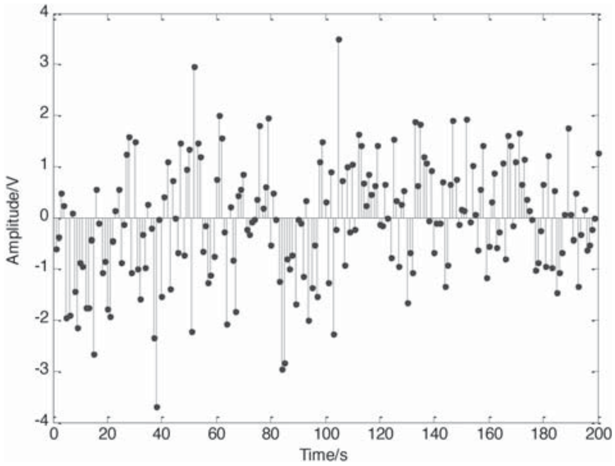

Figure 6 Wireless sensor network array signals received.

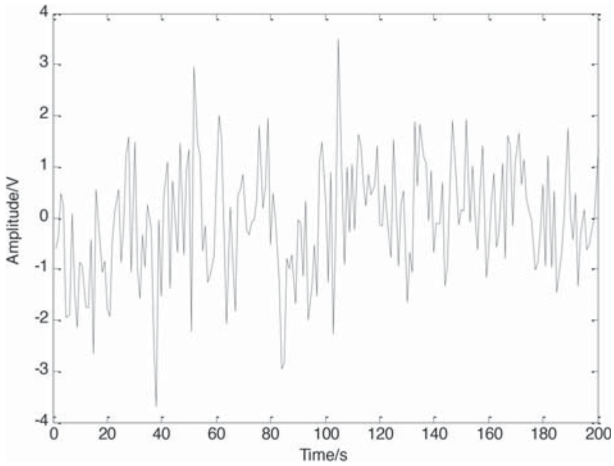

Figure 7 Signal synchronous transmission output.

frequency of the wireless sensor network array signals is 120 KHz, the sampling amplitude of the signals is 56 dB, the proportion of pulse components in noise is 0.78, the bandwidth detected by the low-power CMOS front end is 40 dB, the order of the adjustable amplifier is 7, and the average measure is 4. The wireless sensor network array signals are synchronously transmitted within this simulation environment and parameter settings. The received wireless sensor network array signals are shown in Figure 6.

Taking as input the collected signals shown in Figure 6, gain adjustable amplification processing is carried out according to the synchronous transmission control output result of the wireless sensor network array signals, and a gain adjustable amplifier is constructed to optimize the synchronous transmission of the wireless sensor network array signals. The detection output is shown in Figure 7.

Analysis of Figure 7 shows that the proposed method has higher precision for the synchronous transmission of wireless sensor network array signals and better anti-interference in the detection process.

The output signal-to-noise ratio of the test signal is shown in Table 1. Table 1 shows that the output signal-to-noise ratio of synchronous transmission of wireless sensor network array signals achieved by the proposed method is relatively high.

6. CONCLUSION

In this paper, a synchronous transmission method for wireless sensor network array signals based on large data environment and adaptive parameter adjustment is proposed. This involved: building a wireless sensor network array signal receiving model, filtering the wireless sensor network array signal by adopting a gain amplification and output steady-state adjustment method, performing gain amplification and characteristic separation of the wireless sensor network array signals by means of a high-resolution signal fusion filtering detection technology, extracting spectral characteristic quantities of the wireless sensor network array signal, and performing output integration of the wireless sensor network array signal by applying an autocorrelation beam-forming method.

The synchronous transmission control of wireless sensor network array signals is achieved, gain adjustable amplification processing is carried out according to the synchronous transmission control output result of wireless sensor network array signals, gain adjustable amplifiers are constructed, and the synchronous transmission optimization of wireless sensor network array signals is achieved. The analysis shows that the output accuracy of synchronous transmission of wireless sensor network array signals is better, the characteristic

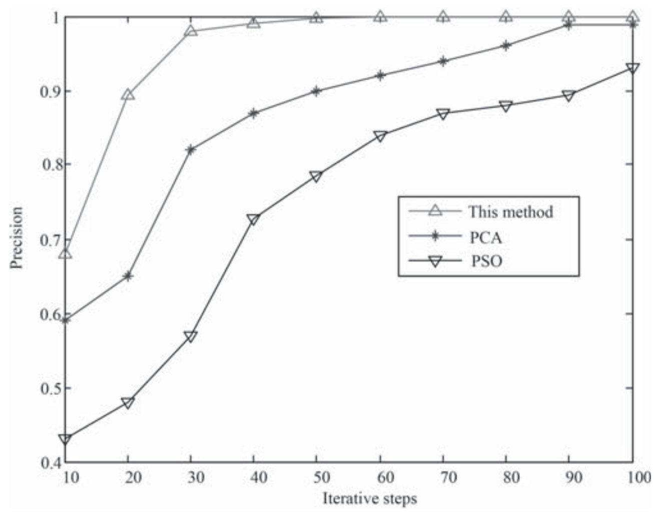

Figure 8 Comparison of detection performance.

Table 1 Output signal-to-noise ratio (unit: dB).

Number of iterations	This method	Reference [2]	Reference [3]
100	44.4	21.3	13.6
200	54.7	25.4	14.7
300	56.2	27.3	16.8
400	62.2	29.8	27.9

resolution is stronger, and the signal-to-noise ratio of signal output is higher.

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