Hindawi
Journal of Sensors
Volume 2022, Article ID 1612715, 11 pages
https://doi.org/10.1155/2022/1612715

Research Article

Sensor Mathematical Model Data Fusion Biobjective Optimization

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Received 16 September 2021; Accepted 3 December 2021; Published 10 January 2022

Academic Editor: Guolong Shi

Sensors are an important tool to quantify the changes and an important part of the information acquisition system; the performance and accuracy of sensors are more strictly desired. In this paper, a highly sensitive fiber optic sensor for measuring temperature and refractive index is prepared by using femtosecond laser micromachining technology and fiber fusion technology. The multimode fiber is first spliced together with single-mode fiber in a positive pair, and then, the multimode fiber is perforated using a femtosecond laser. The incorporation of data model sensors has led to a rapid increase in the development and application of sensors as well. Based on the design concept and technical approach of the wireless sensor network system, a general development plan of the indoor environmental monitoring system is proposed, including the system architecture and functional definition, wireless communication protocols, and design methods of node applications. The sensor has obvious advantages over traditional electrical sensors; the sensor is resistant to electromagnetic interference, electrical insulation, corrosion resistance, low loss, small size, high accuracy, and other advantages. The upper computer program of the indoor environment monitoring system was developed in a Visual Studio development environment using C# language to implement the monitoring, display, and alarm functions of the indoor environment monitoring system network. The sensor-data model interfusion with each other for mutual integration performs the demonstration of the application.

1. Introduction

Sensors are an important tool for human beings to quantify the changes and status of the outside world and are an important part of the information acquisition system. With the development of society and technological progress, people's thirst for the performance and accuracy of sensors has become more stringent. People's research on fiber optic communication and fiber optic sensing technology first began in the early 1970s; since the first quartz optical fiber developed by Corning, the development of optical fiber has revolutionized the communications industry, due to the huge information transmission capacity of optical fiber, coupled with low loss, small size, lightweight, and other advantages, so optical fiber has become the main medium for long-distance communication transmission, telephone, Internet, cable TV, industrial networks, etc. [1]. Telephones, the Internet, cable TV, industrial networks, etc. are also gradually choosing optical fiber as a communication medium. Multisensor information fusion is a multifaceted, multilevel, and multilevel integrated processing of information from multiple sensors, eliminating the possible contradictions and redundancies between multiple sensors, reducing the uncertainty of information, to generate new and effective information, which is not available to any single sensor. With the increasing demand for human information intelligence in multisensor systems, multisensor information fusion as an active and emerging research area is receiving more and more attention. At present, a multisensor information fusion system has been widely used in the fields of identification, intelligent robotics, criminal investigation, industrial monitoring, remote sensing technology, etc. The research on multisensor information fusion technology and its application can effectively improve the information intelligence of the multisensor system [2]. This paper collates, analyzes, and summarizes the research results in the field of multisensor information fusion at home and abroad in recent years and provides a systematic introduction to various aspects of multisensor information fusion. Through the introduction of the information fusion concept, comparison of fusion algorithms, and analysis of computer simulation examples, certain research on multisensor information fusion technology and its applications are made.

With the continuous development of fiber optic technology, sensors have also been widely studied; sensors are an important tool for human beings to obtain external information; with the development of society and the gradual improvement of people's living standards, people's requirements for sensors are increasingly high, not only in terms of sensitivity; the range of information measurement, distance, and other requirements are also gradually improved. Traditional electrical sensors due to electromagnetic interference, small transmission capacity, short life, security, and low stability, and other shortcomings gradually meet people's production life; sensors are an important part of the sensor; the rapid development in recent years is due to the sensor than the traditional electrical sensors with electromagnetic interference, small size, lightweight, no environmental hazards, good repeatability, corrosion resistance, low loss, high sensitivity, structural diversification, which can be used to measure information. Sensitivity, structure diversification, distributed sensing, and other obvious advantages make sensors have many unique environmental applications with strong adaptability; to certain physical parameters for accurate measurement, high reliability can be used to measure temperature, strain, displacement, pressure, refractive index, and other types of physical parameters, so it is widely used in bridge inspection, petrochemical, food safety, and production life and many others. Therefore, it is widely used in many important fields such as bridge inspection, petrochemical, food safety, and productive life. The sensor is a new generation of optical fiber as a transmission medium and can measure information into light as the carrier of the optical signal, by detecting changes in the optical wave parameters of light transmission in the optical fiber, to make an accurate measurement of the external environment temperature, refractive index, and other changes in technology.

Sensors have various classifications and can be classified as internally modulated sensors and externally modulated sensors based on the type of sensor. Internal modulated sensors are also known as intrinsic sensors; the internal modulated sensor modulation zone is located in the optical fiber; the fiber directly as a sensitive element has both light emission and coupling done in the same fiber, so this type of sensors are also known as all-fiber sensors or functional sensors, which is currently more widely used in fiber-optic gyroscopes; external modulated sensors are also known as nonfunctional sensors Also called light-transmitting sensors, in this type of sensor modulation area outside the fiber, the fiber is only used as a medium to transmit the signal light detected by the sensitive elements of environmental changes. Functional sensors are also divided into fiber grating sensors and interferometric sensors. Fiber grating type sensors are mainly divided into long-period fiber grating and short-period fiber grating two types of sensors. According to the different modulation methods, the sensor can be divided into intensity-modulated sensors, wavelength-modulated sensors, polarization state-modulated sensors, and phase-modulated sensors.

The mathematical model is an optimal solution search algorithm based on Darwin's theory of evolution and Mendel's genetic doctrine. The parameters to be optimized are encoded by computer programming in binary, with each character code being an individual. A group of individuals (called a population) is placed in an optimal solution-seeking environment in which the fitness of the population is calculated and selected according to the evolutionary doctrine of superiority and inferiority. The population is then subjected to crossover and mutation operations based on the ideas of the genetic theory of hybridization and mutation so that the resulting new population is more adapted to the solution environment. The optimal solution adapted to that environment is found by following the above steps of continuous evolution from generation to generation until the optimization criterion is satisfied. The structure of the coupled mechanism is characterized by many parameters that determine its structural model, and in evaluating its performance, there are always multiple performance indicators that need to be taken into account at the same time, so the optimization of the parameters of the parallel structure is a multiobjective multiparameter process. The multiobjective mathematical model can perfectly fit the problem of parallel mechanism optimization, so many scholars use the mathematical model to achieve parallel mechanism parameter optimization. We completed the optimization of structural parameters of a 6-degree-of-freedom parallel robot using a mathematical model with the workspace as the objective function. The literature completed the optimization of eight parallel structure parameters using mathematical models with objective functions including the driving force, speed, and power peak of the hydraulic drive unit. In summary, the multiobjective optimization mathematical model has a good effect for solving the parallel mechanism parameter optimization, but most of them get a single value of the parallel mechanism parameters and do not consider the influence of the structural errors brought by the materialization process on the performance indexes; the application of mathematical model optimization to get the range of sensor elastic element parameters, based on this range of structural parameter values for entity design, can ensure that the performance indexes meet. The structural parameter values based on this range can ensure that the performance indexes meet the working requirements. Sensing technology can be roughly divided into 3 generations. The first generation is a structural sensor. It uses structural parameter changes to sense and transform signals, for example, resistance strain sensor. The second-generation sensor is a solid-state sensor developed in the 1970s. This sensor is composed of solid components such as semiconductors, dielectrics, and magnetic materials. The third-generation sensor is a smart sensor that has just been developed. The so-called smart sensor means that it has certain detection, self-diagnosis, data processing, and self-adaptive capabilities for external information. It is a product of the combination of microcomputer technology and detection technology.

2. Related Work

The prototype of multisensor information fusion technology first appeared at the end of World War II, when optical and radar sensors were used simultaneously in antiaircraft gun control systems [3]. The combination of optical and radar sensors made full use of the characteristics of both sensors, which not only improved the anti-interference capability of the system in a harsh climate but also effectively improved the measurement accuracy of the control system. However, the fusion was done manually at that time [4], which was slow and not too high quality, and this control system did not have a significant impact on the war situation and did not attract enough attention [5]. The research institutions of country A began to study the automatic and integrated processing of information, and information fusion was formally proposed in the sonar signal processing system financed by the Ministry of Defense of country A, which was the earliest manifestation in the system. At that time, when detecting enemy ships in a certain sea area [6], the effect of clutter made the target identification based on sonar very unsatisfactory, and the researchers accidentally used a microcomputer to fuse multiple independent sonar signals and found that they could accurately detect the location of enemy ships. Since then, multisensor information fusion technology has flourished [7], and the military of country A has gradually launched systematic research on the proposed use of multisensors to collect battlefield information. Not only that but also in the fields of marine surveillance [8], robotics, industrial control, etc., there has been a gradual development towards multisensor.

In recent years, the uncertainty study of dynamic calibration of sensors has gradually matured, and the model uncertainty study of sensors is still in the preliminary exploration stage [9]. The literature proposes a two-step MCM method for assessing the uncertainty of dynamic calibration of nonlinear systems, which provides a new method for uncertainty assessment of dynamic calibration of sensors. The literature analyzes the main uncertainty components affecting the dynamic calibration results of sensors and calculates the synthetic uncertainty by establishing an uncertainty transfer model. The method not only obtains the synthetic uncertainty of the system [10] but also provides a basis for the traceability of the uncertainty of the dynamic calibration device, but the accuracy of the uncertainty assessment results depends on each uncertainty component [11]. In sensor calibration experiments, there are large differences in the sources of uncertainty, and the uncertainty transfer coefficients and the covariance functions of different components are difficult to determine, leading to difficulties in the calculation process and poor applicability. A dynamic measurement uncertainty estimation method based on the frequency response characteristics of the sensor is proposed in the literature, and the dynamic measurement test of an acceleration sensor is taken as an example [12], and the amplitude-frequency characteristic and phase-frequency characteristic curves of the system are fitted by segments, and the uncertainty of the dynamic measurement is obtained according to the amplitude and frequency range of the input signal and the confidence factor [13]. The literature proposes a method for calculating the uncertainty of dynamic characteristic parameters of sensors based on model parameter identification, where the dynamic calibration of sensors is repeated and the generalized least squares method is applied to model the dynamic characteristics, and the sample values of dynamic characteristic parameters such as rise time, overshoot, and operating frequency band are derived from the identified time-domain model, and the standard uncertainty is calculated using Bessel's formula. This method is a standard uncertainty calculated by the statistical method with a small number of dynamic calibrations, and the reliability of the assessed results is not high [14]. The literature establishes a mathematical model of atomic clocks, analyzes the influence of random noise on the prediction results, performs formula derivation to obtain the mathematical expression of the prediction uncertainty of atomic clocks based on the mathematical model of atomic clocks, determines the weighting coefficient of the prediction uncertainty of each clock, and derives the prediction model uncertainty of the clock set [15]. The literature proposes a self-help method based on the sensor dynamic.

3. Optimization of Sensor and Mathematical Model Data Fusion

Sensor imaging objective lens will be illuminated by external illumination (or their light-emitting) scenery imaged on the image surface of the objective lens, forming a two-dimensional space of the optical sensor (light intensity distribution), while being able to change the two-dimensional light intensity distribution of the optical sensor into a one-dimensional temporal electrical signal of such a class of sensors, we call the vision sensor [16]. Vision sensor variety, according to its decomposition of optical sensors in different ways, can be divided into three categories: electron beam scanning class, optical machine scanning class, and solid self-scanning class; in sensor mathematical model-data fusion, its optimization, in terms of application will be more efficient. There are many types of sensors, and the most important advantages are mainly the following features: "high precision and strong sensitivity." Among them, the characteristics of sensors include miniaturization, digitization, intelligence, multifunction, systemization, and networking. It is the first link to realize automatic detection and automatic control. The existence and development of sensors give objects the sense of touch, taste, and smell and make objects slowly become alive. It is usually divided into ten categories according to its basic sensing function: heat-sensitive elements, photosensitive elements, gas-sensitive elements, force-sensitive elements, magnetic-sensitive elements, humidity-sensitive elements, sound-sensitive elements, radiation-sensitive elements, color-sensitive elements, and taste sensitive elements.

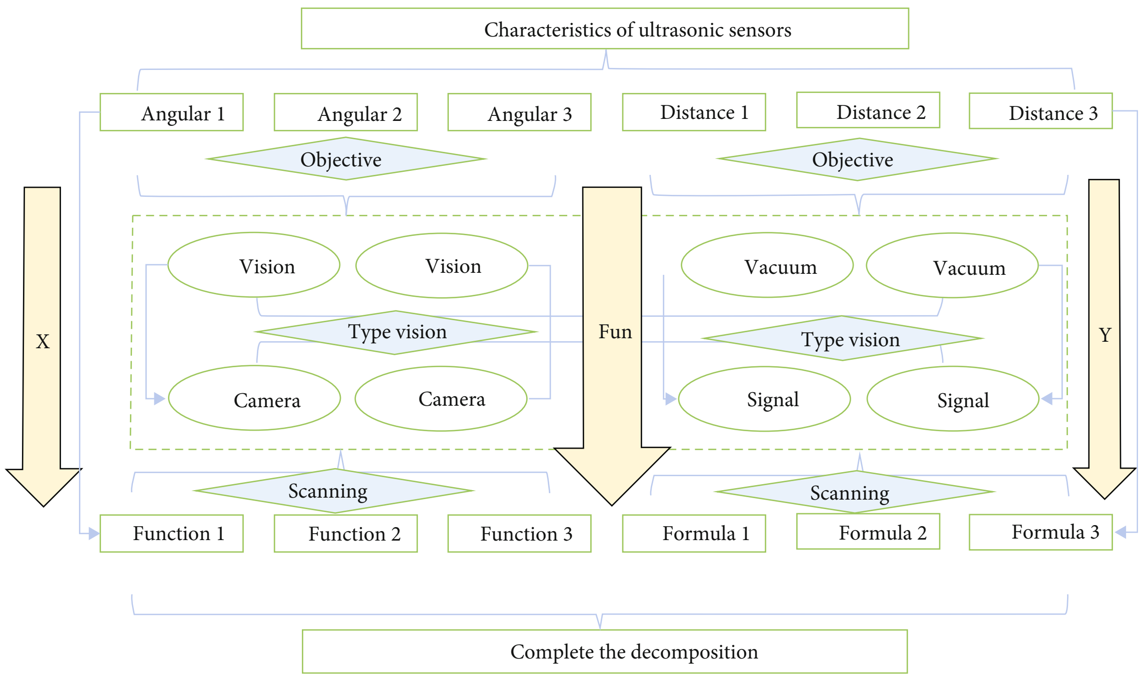

Figure 1: Sensor operation diagram.

3.1. Optimization Scheme for Sensors. Sensors are the material basis of information fusion, of which mathematical models and visual sensor sensors are two types of fusion commonly used in information fusion, to make certain optimizations to existing sensors and increase their efficiency. A mechanical wave with a frequency higher than that of an acoustic wave is known as ultrasound, which can propagate in liquids, gases, solids, or living organisms. The relationship between ultrasonic frequency, velocity, and wavelength is given by the following equation [17]:

$$T = \frac{1}{n}\sum_{i=1}^{n} X_i Y_i + \sum_{i=1}^{n} \left(X_i - \bar{X}\right)^2. \quad (1)$$

The ultrasonic frequency is high, and the current propagation in a certain medium when the speed is certain, which makes it short wavelength, a small bypass phenomenon. Its most significant feature is that the energy is easy to concentrate, has good directionality, and in solids, liquids, gases in the attenuation of small, penetrating ability, encountering the media interface is significant refraction and reflection, and therefore widely used in various industrial sectors of the detection. There are many types of ultrasonic sensors, which are divided into two categories: active and passive. There are many ways to measure distance with ultrasonic waves, such as the resonance method, phase difference method, frequency difference method, and frequency modulation method. Among them [18], the more popular is the pulse-echo method, which is also known as the time method. The basic principle is the ultrasonic probe emits ultrasonic waves, ultrasonic waves reach the surface of the object to be measured after the reflection back, the pulse signal is accepted by the probe, record the required degree of time, the speed of sound in the medium, and the degree of time can be obtained from the sensor and the distance to the target. The working principle of the sensor is shown in Figure 1.

The characteristics of ultrasonic sensors mainly include angular characteristics and distance characteristics, respectively; using the angular trust function, the principle of the formula is as follows:

$$A = \frac{1}{n}\sum_{i=1}^{n} X_i Y_i + \frac{1}{n}\left(\frac{x-\mu}{\sigma}\right). \quad (2)$$

Electron beam scanning vision sensor is an early sensor, such as pyroelectric camera tube and vacuum vision tube. Electron beam scanning type vision sensor through the imaging objective lens image the subject scene on the face of the camera tube, in the form of surface resistance distribution or the form of boot surface potential distribution of optical intensity distribution of the optical sensor stored in the face, while through the electron beam will be detected and extracted; the electron beam in the role of the deflection coil, field scanning, and line scanning complete the decomposition of the entire sensor (or scanning), the formation of the visual sensor signal. Optical scanning vision sensors are divided into unit optical scanning types and multiple optical scanning types. The unit optical machine scanning type uses a photoelectric sensor with a mechanical scanning device to perform line scanning and field scanning [19]. The multioptical machine scanning type uses multiple photoelectric sensors in an orderly row, and the scanning output signal is read out in the scanning order to form the sensor signal.

With the development of chip manufacturing technology and signal processing technology, there is an emergence of new vision sensor sensors such as vision sensor sensors and vision sensor sensors. This type of visual sensor itself with line scan, field scan function, the use of the principle of electrical effect, directly on the imaging objective lens into the charge density distribution of the charge sensor, follows certain guidelines under the driving action of the pulse a line of output, the formation of the visual sensor signal. CMOS and CCD visual sensor research started almost simultaneously, due to the time process level being low with the immaturity of semiconductor technology, vision sensor collection of low resolution, poor quality, light sensitivity is not enough, and the noise can not be reduced; at that time, it did not cause enough attention to researchers. And vision sensor because there are fewer pixels and low noise, high sensitivity has been occupying the mainstream market. Due to the improvement of process level and integrated circuit design technology, researchers have found that some of the shortcomings of the visual sensor can find ways to overcome and has no inherent characteristics of the visual sensor, such as high integration, small size, low power consumption, and lightweight, making the visual sensor become a hot spot for research in recent years [20].

In a typical sensor network, the information collected by a local node needs to be sent to a central processor that is located at a relatively long distance. If the transmission distance is long, the information will first be sent to a relay node and then the data will be forwarded to the destination node based on multihop routing, techniques that save energy in fading channels. Due to the small physical size of the sensor nodes, it is not practical to install multiple antennas directly on each node. If there is collaborative transmission between multiple nodes at the transmitter side, the system can be viewed as a multiantenna equivalent. Using this equivalent system, the transmission energy required for long-distance transmission can be significantly reduced. To make collaborative transmission possible, it is necessary to perform local data exchange before long-distance transmission. The energy consumed by the local data exchange is less than the energy saved by using the structure. In addition, the scheme and the noncollaborative scheme have different delay parameters. In this chapter, the energy efficiency and delay of the scheme and the noncollaborative scheme will be compared and the more efficient scheme will be selected.

3.2. Optimization of Mathematical Model Data. In the three-phase stationary coordinate system, the variables in the mathematical model of the PMSM have actual physical significance and the equations better reflect the optimization relationships, which are optimized by the following equation principles:

$$B = \frac{1}{n}\sum_{i=1}^{n} X_i Y_i + \sum_{i=1}^{n} X_i^2 - \sum_{i=1}^{n} X_i. \quad (3)$$

The vector control of the PMSM mathematical model in the two-phase stationary coordinate system is based on the mathematical model in the two-phase rotating coordinate system by transforming the PMSM mathematical model in the three-phase stationary coordinate system with CLARK. In the two-phase rotating coordinate system, the sinusoidal quantities in the α-β coordinate system behave as constants and the control is simpler and the d-axis current and q-axis current can be decoupled by vector control. The voltage equation is given by

$$F = \frac{\Delta y}{\Delta x} \cdot \frac{\delta y}{\delta x} \cdot \frac{\partial^2 \Omega}{\partial u \partial v}. \quad (4)$$

In the optimization application of mathematical models, it is necessary to extract a certain signal and its differential signal in a relatively high interference environment; for extracting these signals, the most used are filters and linear differentiators, but these tools have weak anti-interference ability and cannot effectively extract these signals in a relatively high interference occasion. The nonlinear differentiator introduces a more efficient and faster response nonlinear function, the fastest control synthesis function, which makes the extracted differential signal more accurate and can arrange the transition process and generate derivatives of each order according to the input given and the characteristics of the controlled object, which can solve the conflict between fast response performance and overshoot. For the second-order system, the mathematical model of the discretized maximum speed tracking differentiator is

$$W = \frac{1}{n}\sum_{i=1}^{n} \left(X_i - \bar{X}\right)^2 \cdot \left(\frac{x - \mu}{\sigma}\right). \quad (5)$$

The dilated state observer is an improvement on the classical observer by expanding new variables to observe the internal part of the system and the external perturbations, and then compensating for them so that the system is equivalent to the simplest integral series type system. Moreover, the nonlinear dilated state observer introduces a nonlinear function to make the observations more accurate and responsive. Therefore, the dilated state observer is considered to be the core of self-resistance. For any Nth-order system, an $N+1$th-order dilated state observer can be designed without knowing the specific mathematical model.

3.3. Biobjective Optimization for Sensor Mathematical Model Fusion. The essence of multisensor information fusion is a functional limitation of the human brain's integrated processing of information (sounds, smells, and sights) combinations from various sensors (ear, nose, eyes, etc.) of the human body. Multisensor information fusion is also known as information fusion; according to domestic and international research results, a more precise definition of information can be summarized as the information processing process that uses computer technology to automatically analyze and synthesize the observed information from several sensors obtained in time sequence under certain guidelines

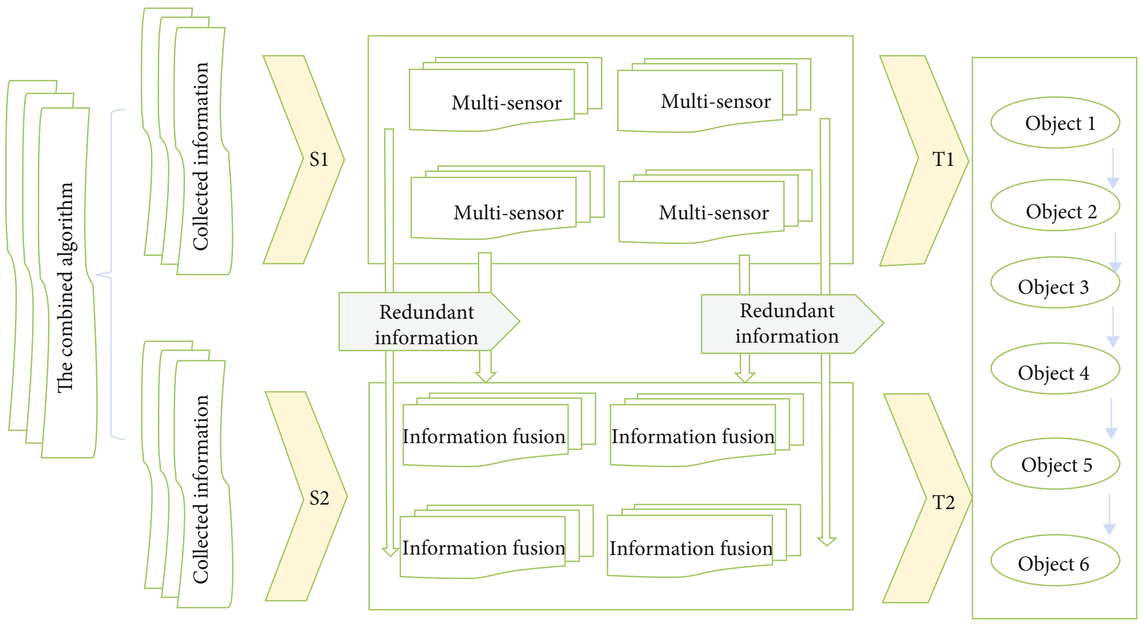

Figure 2: Sensor and mathematical model data fusion process.

to accomplish the required decision-making and estimation tasks; the hardware basis of information fusion is a multisensor system, in this paper, the mathematical model. The hardware basis of information fusion is a multisensor system, in this paper, the mathematical model and the visual sensor; the processing object of information fusion is multisource information, i.e., the mathematical model and the information collected by the visual sensor; the core of information fusion is coordinated optimization and integrated processing, i.e., the integrated processing of the collected information using information fusion algorithms. The hardware basis of information fusion is the multisensor system, in this paper, the mathematical model and the visual sensor; the processing object of information fusion is the multisource information, i.e., the information collected by the mathematical model and the visual sensor; the core of information fusion is coordinated optimization and integrated processing, i.e., the use of information fusion algorithms to integrate the collected information.

The combined algorithm synthesizes the collected information. Multisensor information fusion combines complementary or redundant information from multiple sensors in time or space based on a criterion to obtain a consistent description or interpretation of the object under test. The basic goal is to derive more information through the combination of information rather than the individual elements that appear in the input information, which is the best synergy.

The result, which is to take advantage of multiple sensors combined or cocombined, is to increase the effective sensor system sex. The multisensor information fusion process is shown in Figure 2.

The functional models of information fusion vary due to the different application domains. The history of information fusion has seen many different models of information fusion, such as the I/O functional model. The research on information fusion firstly proposed the functional model of information fusion which has been adopted by most of the practical applications, and now, we focus on the functional model of information fusion.

Figure 3 shows the functional model of the expert group after several revisions oriented towards the information fusion results. The purpose of this model is to facilitate easier communication and understanding between designers, system managers, evaluators, and theoretical researchers, so that the design, development, and implementation of the whole system can be completed efficiently and smoothly.

When the information fusion function model was first proposed, it was divided into three levels, which were later revised to five levels according to the actual application, but the so-called “levels” here do not refer to the time continuity, but actually, the levels are processed in parallel. The following describes each level of information processing. Level zero (information preprocessing) used to compress, format, standardize, batch, sequence, and other processing of information from the sensor information base inside and outside the system, to meet the subsequent levels of estimation and processor requirements for the order and amount of computation. For example, the camera acquisition of the original sensor due to random interference and a variety of conditions (noise, lighting, etc.), so that the system to obtain the sensor is not perfect, often need to use sensor processing technology to obtain the original sensor for preprocessing, the sensor for noise filtering, distortion correction, and greyscale correction, etc., is the information preprocessing operations. In the first level (state estimation), state estimation is a low-level processing layer, which belongs to the numerical technology process, the main functions include attribute parameter estimation, data alignment and association, identity estimation, target position, and

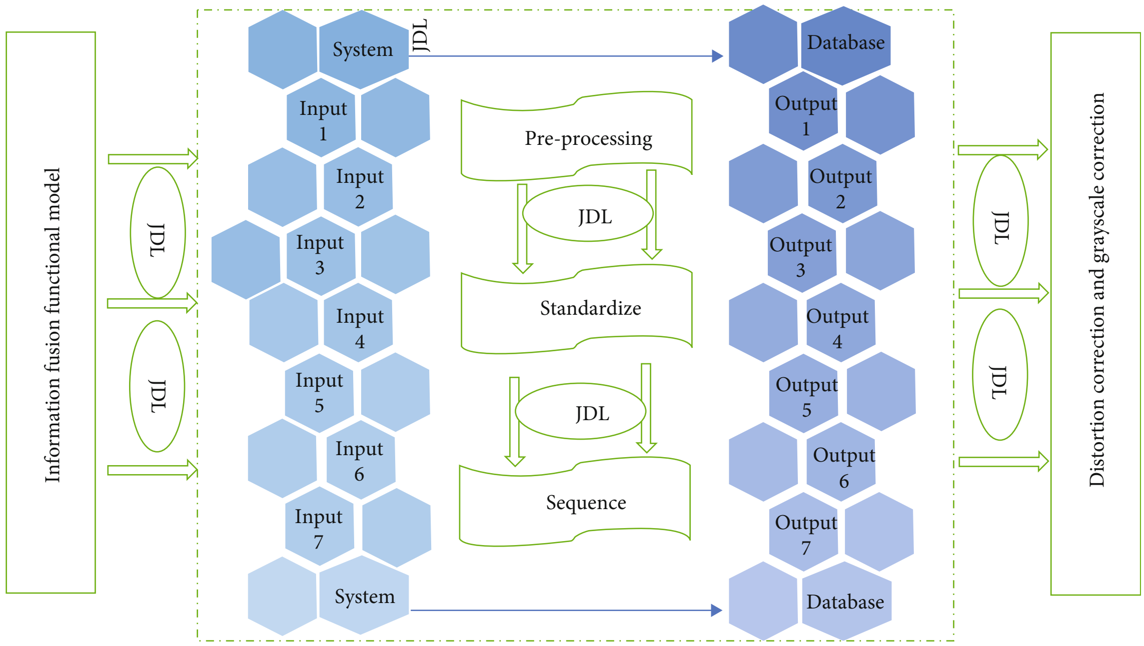

FIGURE 3: JDL information fusion functional model.

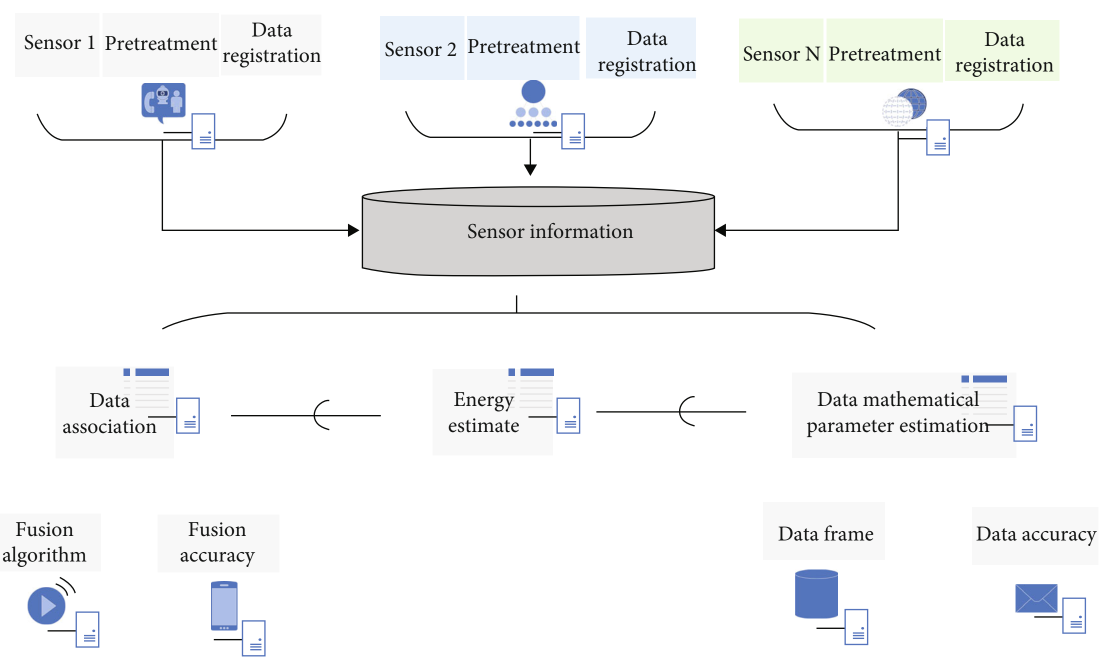

FIGURE 4: Flow chart of sensor mathematical model fusion.

kinematic parameter estimation. Data alignment and correlation is to first calibrate the information received from each sensor or sensor in time and space and then correlate the point traces from each sensor with the individual traces in the information base and simultaneously predict the target position. One level of processing for this evaluation model is shown in Figure 4. The purpose of this level of processing is to provide a more high-level fusion that provides supporting decision information. The flow chart is shown in Figure 4.

Information fusion performs multiple levels of processing on multiple sources of information, each level of processing is a certain degree of abstraction from the original data, and it mainly includes processing of information such as detection, calibration, correlation, and estimation. Information fusion can be divided into three levels according to its level of abstraction of information processing in the fusion system: pixel layer fusion, feature layer fusion, and decision layer fusion. Pixel layer fusion is the lowest level of fusion, which is performed directly on the original observed information layer collected by the sensor, i.e., the information is synthesized and processed before the original information is preprocessed, and then, the feature

Table 1: Display of the results of the fusion of sensors and mathematical models.

Sensor type	Efficient	Precision	Accuracy
Ordinary sensor	85	77	90
Sensors fused with mathematical models	90	86	94
Sensors incorporating complex mathematical models	95	92	99

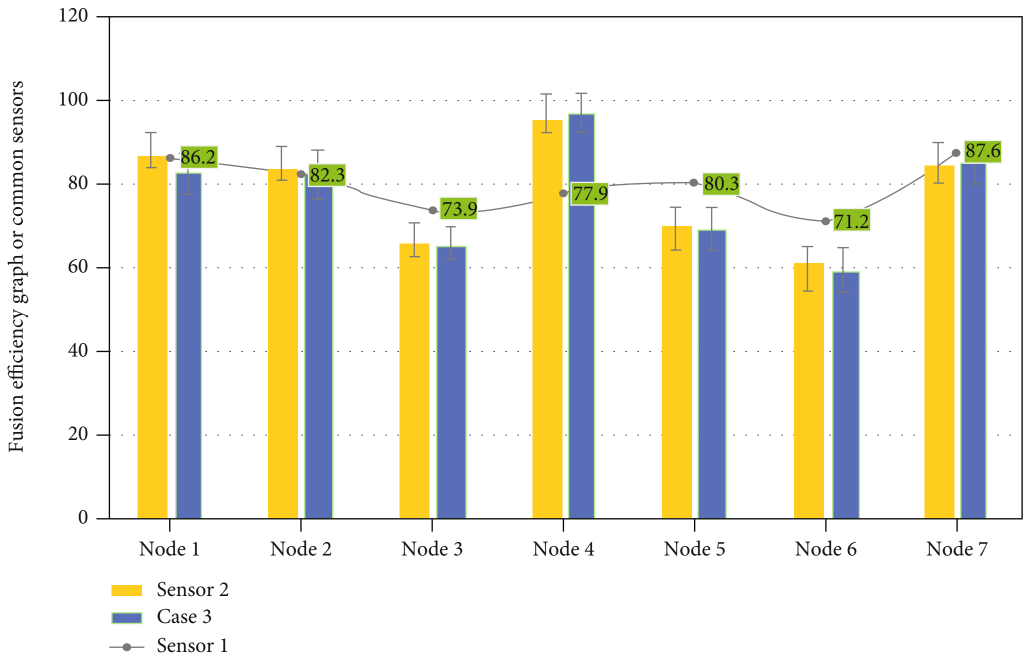

Figure 5: Fusion efficiency graph for common sensors.

vector is extracted from the fused information for target identification. Pixel layer fusion requires that the sensor must be homogeneous, i.e., the sensor observes the object of the same physical quantity or phenomenon. The advantages of pixel layer fusion are obvious, i.e., the loss of information is very small, it can provide some subtle information that feature layer and decision layer fusion cannot provide, and the data is accurate. However, its limitations are also very obvious: the amount of information is large, so it requires high system bandwidth, time-consuming processing, and poor real time; because the fusion is collected in the original information, the information has uncertainty, incompleteness, instability, and necessarily requires the system to have a relatively high error correction ability when fusion; this requires the sensor to be homogeneous, that is, the sensor observation of the object is the same physical quantity or phenomenon; the amount of communication is large, and the anti-interference ability is relatively poor.

4. Experimental Results and Analysis

4.1. Experimental Results. To verify the effectiveness and accuracy of the methods used in this question, the experimental sections of this question select the representative methods such as pixel point-based sensor fusion method, mathematical model optimization-based sensor fusion method, Contourlet transform-based sensor fusion method, double-layer NSCT transform-based sensor fusion method, and NSCT+PCNN-based sensor fusion method, respectively. A comparative analysis is performed in terms of sensor fusion accuracy and time consumption. The experimental environment is MATLAB2012a, and the computer used for the experiment is the Lenovo Core series with a 3.2 GHz CPU and 4 G memory.

This experiment first selects representative test images UNcamp IR and visible sensor set to verify the effectiveness of the method in this paper as well as the fusion accuracy and efficiency. Table 1 shows the results of the fusion experiments.

4.2. Experimental Analysis. The fusion results of the methods in this section with each of the comparison methods for image fusion of the UN camp image set are shown in Figure 5. From the fusion results of each method in Figure 5, it can be seen that although the pixel point-based fusion method and the wavelet transform based fusion method can highlight the infrared target significantly, the detailed information of the visible image is lost in the fusion result and the texture information of the original image cannot be reflected. The fused image based on Contourlet transform can clearly show the infrared target, but there is some

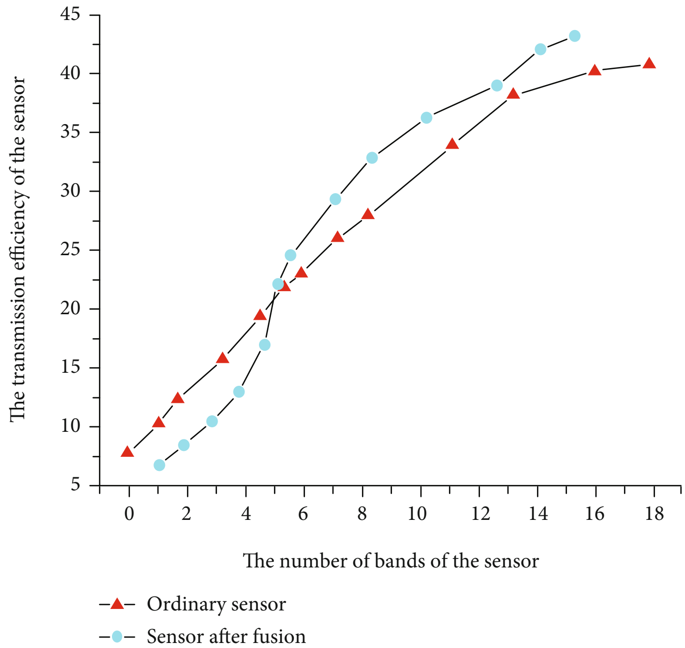

Figure 6: Efficiency graph after fusion of sensor and mathematical model.

distortion and distortion in the lower-left corner of the fused image, and the image is rougher in this region, and the fused image cannot better represent part of the texture information of the visible image. The fused image based on the double-layer NSCT transformation has a better representation of the visible texture part, and the infrared target can also be highlighted, but there is a small amount of image distortion in the result. The NSCT+PCNN-based fusion image can highlight the advantages of both infrared and visible images, especially the infrared target is highlighted more obviously, but some details of the visible image are missing in the lower region of the image. The fused image of this chapter can clearly distinguish the IR target, and at the same time, the texture information of the visible image can be better preserved, especially the right and lower regions of the image are better than other comparison methods in terms of detailed texture information of the visible image.

In communication systems, the size of the system transmission delay is also one of the important criteria to measure the performance of a communication system. Especially for energy-limited wireless sensor networks, if the transmission delay is too large during the whole communication process, it will increase the energy loss of sensor nodes to a certain extent and then affect the efficiency of the whole communication network. And the wireless sensor network has a wide range of applications, and there may be some special applications where the system time delay is required to be high. Therefore, the magnitude of system time delay is also an important direction of study in this paper, and in this section, we will study the performance of time delay of the collaborative scheme and noncollaborative traditional transmission scheme. Figure 6 then represents the efficiency graph of processing images after fusion of the sensor with the mathematical model.

Figure 7 shows the comparison of transmission delay performance of the scheme and noncollaborative scheme. It can be seen from the figure that when the transmission distance is in a certain interval, the transmission delay of the transmission scheme is smaller. Because the link has more capacity than the link, a larger constellation size can be chosen to reduce the circuit energy consumption when the transmission distance is shorter. Because the use of a larger constellation size overcomes the delay overhead of local communication between the transmitter and receiver sides of the scheme, the transmission delay of the scheme is smaller when the transmission is at a distance. As the transmission distance continues to increase, the transmission energy will become the major overhead in the total energy, at which point the optimal constellation size becomes for both the scheme and the noncollaborative conventional scheme. This leads to equal transmission delay over long distances for both schemes, and again, since the scheme contains some additional communication delay due to the local information flow, the transmission delay of the scheme is greater than that of the non-collaborative conventional scheme in this case. Also, it can be seen from the two figures above that there exists a distance interval (from-to) in which the scheme has superior performance in terms of both energy consumption and delay. Figure 7 shows a comparison of the efficiency of the sensor and mathematical model after data fusion optimization.

As shown in Figure 8, the use of scheme transmission in wireless sensor networks is similar to the use of scheme transmission in that there is a threshold (in this case threshold) at which the total energy efficiency of the transmission scheme will be higher than the noncollaborative conventional transmission scheme when the transmission distance And as the transmission distance increases, the energy saved

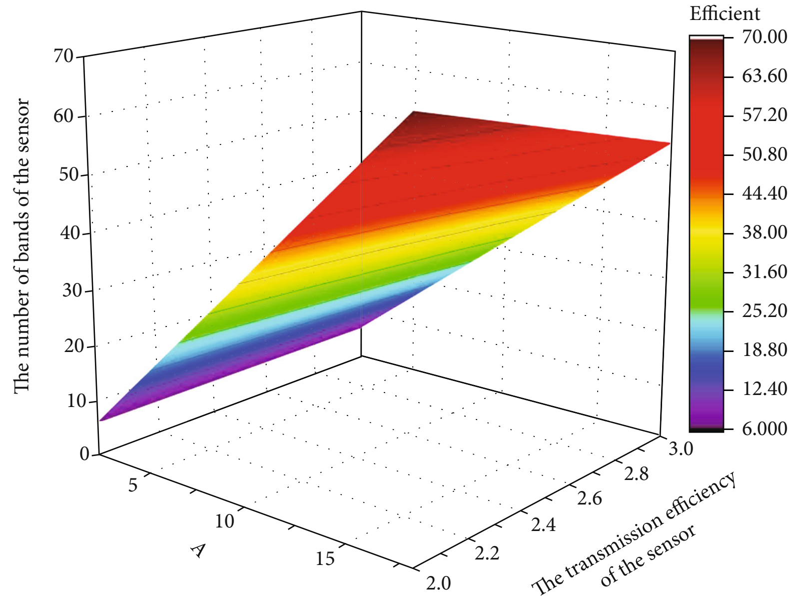

Figure 7: Comparison of the efficiency of sensor and mathematical model data fusion optimization.

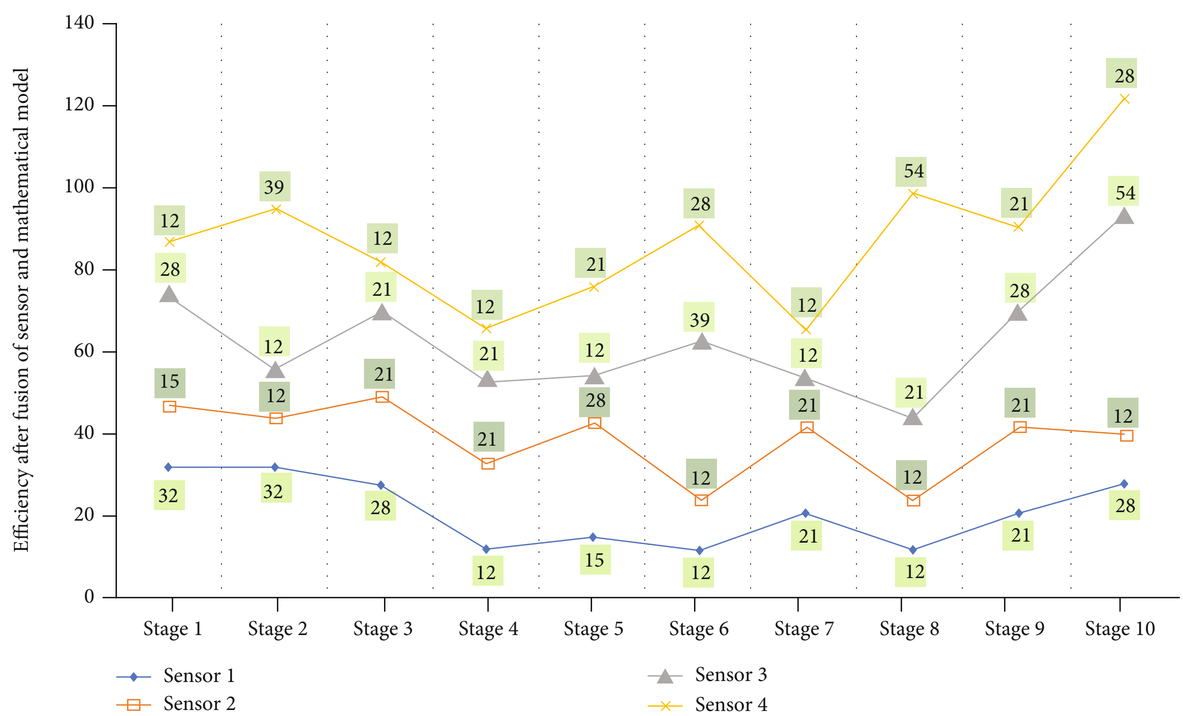

Figure 8: Comparison of efficiency after fusion of sensor and mathematical model optimization.

by using the transmission scheme becomes more and more significant. When the time comes, the use of the transmission strategy can save around energy than the noncollaborative traditional transmission strategy.

5. Conclusion

This paper addresses the problem of inefficient fusion with mathematical models in the process of multi-sensor ranging, and the algorithm is proposed in this paper after principle analysis and algorithm simulation, which is optimized. The algorithm makes full use of the observed values with the estimated values of each historical moment based on adaptive weighting, and the estimated values are estimated by constructing pseudo values.

The experimental results show that the data processing is better than the ordinary processing method in terms of accuracy and robustness after the combination of the knife-cutting method and adaptive weighting. The multisensor information fusion based on grey theory is studied. Reliability weights, greyscale measure adjustment weights, and orphan points are introduced for the case where the possible conflict of information from sensors makes the grey measure larger. The grey fusion algorithm is used for map construction in a fully autonomous robotic soccer system by applying the concept of grey number to represent the uncertainty information of ultrasonic sensors, creating a subgrid map of a single robot, and obtaining a global raster map by grey fusion of multiple subgrid maps through real-time collaboration between multiple robots. The experimental results show that the global raster map created by the robots can better reflect the basic situation of the obstacles in the environment to achieve the map building of the fully autonomous robotic soccer game system. The whole experiment also reflects that the efficiency of the sensor and the mathematical model is also substantially improved after combining them. In the future development direction of the article, since the combination of knife-cutting method and adaptive weighting, the accuracy and robustness of data processing are better than ordinary processing methods. Multisensor information fusion based on grey theory is studied. For future development, the direction is to pay more attention to the integration with other models.

Data Availability

The data used to support the findings of this study are available from the corresponding author upon request.

Conflicts of Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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