

Information Fusion Technology Based on Multi-sensor

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Abstract

Multisensor information fusion is an information processing technology used to contain multiple or multiple sensors in different locations. With the development of sensor application technology, data processing technology, computer software and hardware technology and industrial control technology, multi-sensor information fusion technology has become a hot new subject and technology. The research of multi-sensor information fusion technology in China has been applied to information location and recognition in engineering. Moreover, it is believed that with the progress of science, multi-sensor information fusion technology will become a specialized technology for comprehensive processing and research of intelligent and refined data and information images.

Keywords

Multisensor; Information fusion; Technology.

1. Introduction

The so-called multi-sensor information fusion (MSIF) is an information processing process that uses computer technology to automatically analyze and synthesize information and data from multi-sensor or multi-source under certain criteria to complete the required decision-making and estimation. ^{[1] [2]}

2. Basic Principles

The basic principle of multi-sensor information fusion technology is the same as the process of human brain processing information synthetically. It makes all kinds of sensors carry out multi-level and multi spatial information complementary and optimized combination processing, and finally produces the consistent interpretation of the observation environment. In this process, we should make full use of multi-source data for reasonable control and use, and the ultimate goal of information fusion is to derive more useful information through multi-level and multi-faceted combination of information based on the separated observation information obtained by each sensor. It not only makes use of the advantages of multiple sensors cooperating with each other, but also comprehensively processes the data from other information sources to improve the intelligence of the whole sensor system.

3. Architecture

According to different data processing methods, there are three kinds of information fusion system architecture: distributed, centralized and hybrid.

Distributed: the original data obtained by each independent sensor is processed locally, and then the results are sent to the information fusion center for intelligent optimization and combination to obtain the final results. The distributed architecture can be divided into the distributed architecture with feedback and the distributed architecture without feedback.

Centralized: the original data obtained by each sensor is sent directly to the central processor for fusion processing in a centralized way, which can realize real-time fusion. The data processing accuracy is high, and the algorithm is flexible. The disadvantages are high requirements for the processor, low reliability, and large amount of data, so it is difficult to realize; Hybrid: in the hybrid multi-sensor information fusion framework, some sensors adopt centralized fusion mode, and the remaining sensors adopt distributed fusion mode. The hybrid fusion framework has strong adaptability, takes into account the advantages of centralized fusion and distributed, and has strong stability. The structure of hybrid fusion is more complex than that of the former two, which increases the cost of communication and computation.

4. Theory and Method of Multisensor Information Fusion

4.1 Kalman Filter (KF)

The process of Kalman filter processing information is generally prediction and correction. It is not only a simple and specific algorithm, but also a very useful system processing scheme. In fact, it is similar to many systems' methods of processing information data. It uses the method of iterative recursive calculation in mathematics to provide an effective statistical optimal estimation for the fusion data, but the storage space and calculation requirements are very small, which is suitable for the environment with limited data processing space and speed. KF is divided into two types: distributed Kalman filter (dkf) and extended Kalman filter (EKF). Dkf can make the data fusion completely decentralized, and EKF can effectively overcome the impact of data processing errors and instability on the information fusion process.

4.2 Artificial Neural Network Method

By imitating the structure and working principle of human brain, this method takes the data obtained by sensors as the input of network, and completes certain intelligent tasks on the corresponding machine or model through the training of network to eliminate the interference of non-target parameters. Neural network method has obvious effect on eliminating the cross influence of various factors in multi-sensor cooperative work, and it is easy to program and stable to output ^[3].

5. Research and Development of Multisensor Information Fusion

Multisensor information fusion technology has a wide range of applications, not only in military applications, but also in civil applications. Military application is the cornerstone of the birth of multi-sensor information fusion technology, including marine surveillance system and military defense system. In the field of civil application, it is mainly used in intelligent processing and industrial control. Intelligent processing includes robot micro surgery and disease monitoring in medicine, especially in smart home.

Problems in Multisensor Information Fusion Technology:

In a multi-sensor system, the data acquired by each distributed sensor will inevitably be restricted by many factors (such as the environment state and the characteristics of the sensor itself). Therefore, in order to develop the multi-sensor fusion technology better, the problem of reducing the correlation ambiguity should be paid more attention;

The basic theoretical system and perfect fusion algorithm need to be improved. Because the vast majority of fusion technologies are carried out in specific application areas. We must establish intuitionistic fusion criterion and form effective data fusion scheme. If we have perfect theory system and fusion model, we can avoid the blindness of fusion technology. For example, asynchronous information fusion algorithm ^[4], quantum neural network information fusion fault diagnosis method ^[5], self-organizing mapping neural network information fusion method, etc., are all new methods worthy of attention.

There are many problems in the implementation of information fusion system and fusion method. For example, the establishment of various fusion models, resource allocation and information

management methods of various sensors are the key technologies to be solved in the field of information fusion.

6. Prospect of Multisensor Information Fusion

Information fusion system is a large complex system with strong uncertainty, and its processing method is limited by the existing theory, technology and equipment. Although this is a new developing discipline, many theories are not perfect, but with the development of various emerging related disciplines and technologies, it will continue to improve and get more practical value.

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