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Multi-Sensor Information Fusion Technology and Its Application in Target Recognition

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ABSTRACT.*With the increasing application of wireless sensor networks and the emergence and application of Internet, information fusion technology has gradually integrated into social life, bringing unprecedented convenience to people's lives. Traditionally, target recognition can only rely on a sensor of a nature to collect target data. Although the operation is simple, the disadvantages are obvious: it can only be applied in a simple environment, and the recognition efficiency and recognition accuracy are low. In this paper, the multi-sensors of the same or different nature are effectively combined, and the original information of the target is obtained at the same time. The multi-azimuth and multi-attribute eigenvalue data of the target are obtained by the feature extraction method, and the feature value data is passed through the feature fusion algorithm. Feature fusion is performed to effectively improve recognition efficiency and recognition accuracy.*

KEYWORDS: *Information fusion, Multi-sensor, Target recognition, Application*

1. Introduction

At present, sensors have been widely used in various fields such as instrumentation, machinery manufacturing, communication equipment, household appliances, health care, and automotive electronics. However, due to the limitations of the performance of individual sensors, the amount of information provided is small and complex. The environment is susceptible to incoherent clutter signals and noise interference, and cannot meet the detection requirements of intelligent systems for multi-target and fast-moving targets.

With the rapid development of computer hardware and software technology, industrial control technology is becoming more and more mature, and multi-sensor information fusion technology has gradually become the research focus in the field of information processing. The development of multi-sensor information fusion technology has achieved certain research results. It is a process of using computer technology to comprehensively analyze information and data of multiple sensors or multiple sources under certain criteria to process information for acquiring target

information. The use of multi-sensor information fusion technology has brought great convenience to people's work and life. Therefore, the research on information fusion technology is very important. This paper also provides some insights on information fusion technology and application.

2. Information Fusion Model

Kangchan Lee et al. proposed an XML-based mediation framework (XMF) model based on the convergence of Internet information resources. It uses a mediator-encapsulator architecture that uses XML to describe information resources and mapping rules to provide an integrated source of information for end users. Based on the E-R-P information management model, Wang Ning proposed an information resource integration platform with entity management, relationship management, problem management and metadata management as the core components. Based on the e-government information process, Huang Cui constructed a portal-based e-government information resource integration mechanism model. Ananthanarayanan provides a data-driven approach to similarity discovery across multiple unstructured data sources so that discovered information can be merged with existing structured information patterns, allowing simultaneous querying on structured and textual data. Brzykcy proposed a semantic fusion model based on XML data in SIXP2P system. Kim et al. proposed a model-driven data fusion (MDDI) model to reduce the complexity of data fusion by separating data and metadata, thus effectively solving the problem of data integration. Zhang Yutao et al. proposed an e-government information resource integration model based on the topic map, and discussed the process and actual implementation of the model in the Metamorphosis theme map environment. Luo Xianchun et al. proposed an e-government information resource integration model based on shared directories.

3. Information Fusion Method

Mediator-based approach: This approach is one of the most well-known methods adopted by many fusion frameworks. It proposes the use of a mediator. A system is responsible for retelling a user query formed on a single schema into a query of the underlying data source in local mode. These data sources contain actual data, while the global schema provides a coordinated, fused, virtual view of the underlying data source. Mapping can be done by using GAV or LAV. When the fused data source is known and stable, GAV should be used. LAV should be used when the fused data source is large-scale and temporary.

Navigation-based approach: Also known as a link-based approach. It is based on the fact that more and more data sources on the network require users to manually browse some web pages to get the information they need. Pure navigation fusion eliminates relational modeling of data, in which data sources are defined as web pages, their connections, and a collection of specific entry points. It also includes additional information such as content, path constraints, and mandatory input parameters. In the information fusion of deep networks, this method is considered to

be crucial, and it needs to extract data hidden behind the Web query interface. However, maintaining the relationship between network resources that change at a certain speed is a daunting task that is considered infeasible in the current network environment.

4. Multi-Sensor Information Fusion Technology

Information fusion is the process of providing a unified view of multiple data sources for users of an integrated information system. Multi-sensor information fusion is based on well-known computer technology, using specific criteria to automatically analyze and process information and data in multiple sensors to complete a complete set of information processing. Multi-sensor information fusion technology was first used in the military field. Multi-sensor technology has been continuously improved with the advancement of science and technology, and has been widely used. According to the latest research results, the information processing and analysis functions contained in multi-sensor systems have far exceeded the human brain's ability to understand information. The human brain is a very complex system that can synthesize, analyze, process and react to various surrounding information. The multi-sensor information fusion technology is also the same concept, but the information and data existing in the system. The processing capacity is several times higher than that of people. Such a system is applied in various industries and is undoubtedly an ultra-high information processing function. As long as the resources of multi-sensors are fully utilized and the sensors are used reasonably, the information and data in each multi-sensor system are complemented in time or space, so that the measured object can be obtained in the multi-sensor system, thereby making the sensor itself has information processing capabilities.

The sensor first completes the information collection, and then comprehensively processes the information. The computer automatic control system finally completes the control of various actions of the robot. Sensor information fusion technology is also known as data fusion technology. Information fusion technology processes the acquired information first, then according to a reasonable fusion method, and finds the connection between the information. Information fusion technology is an information optimization technology that can process and compare information from different angles, obtain the connection between different information, remove useless information, and leave useful information. This is information optimization, which is intelligent information processing. The research pointed out a new direction of development. The information acquired by a single sensor is inaccurate and comprehensive, so the collection of information must be done by multiple sensors. The information acquired by various sensors can be synthesized to characterize the external environment in a complete, accurate and objective manner. The information processed by the information fusion technology has the characteristics of redundancy, complementarity, and low cost of information acquisition. The composition of a typical multi-sensor information fusion is shown in Figure 1.

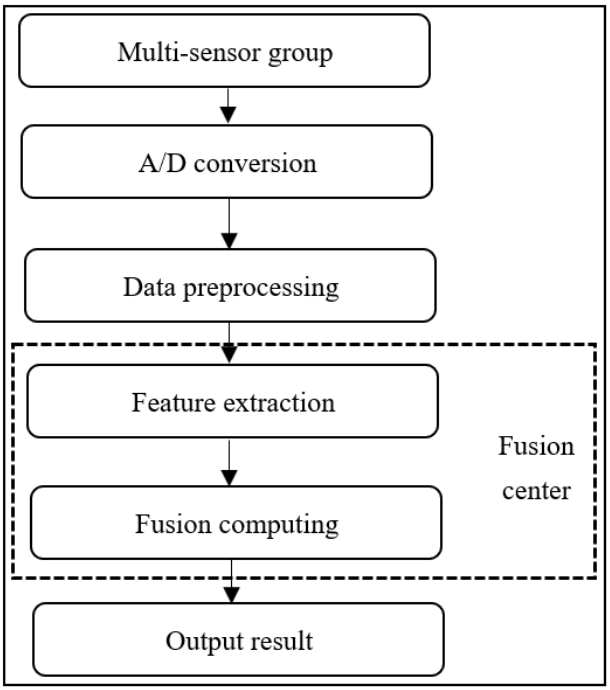

Fig.1 Multi-Sensor Information Fusion Frame

Sensor information fusion technology can be divided into four aspects: information combination, information synthesis, information fusion, and information correlation. Information combination is the most basic data processing method. In order to obtain comprehensive and accurate information, multiple sensor parallel output or complementary output can be selected. Fusion includes two aspects: correlating various data output by the sensor; Correlate sensor data with existing network models within the system; Finally, the relevant results are processed to generate a new information expression. The purpose of information-related processing is to integrate and optimize processes such as identification, prediction, learning, and memory. Obtain the law of the relationship between the sensor data sets, retain the correct information, and eliminate the useless and erroneous information until the robot makes the corresponding judgment and reaction. The hierarchical description of information fusion exists in various practical environments. The fusion processing method is mathematical processing and processing, which makes this information the component information that the computer automatic control system can process, and at the same time completes the fusion of information data.

5. Research on Target Recognition Based on Multi-Sensor Information Fusion

Technology

The target recognition technology of multi-sensor information fusion has many applications in various aspects, and can be applied to many aspects such as military, computer vision, and remote sensing. Therefore, it is of great significance for the research of multi-sensor information fusion. The multi-sensor information fusion target recognition technology can identify the target in a very complex environment, and reduce the amount of information through fusion, so that the recognition efficiency and accuracy of the target are greatly improved. At present, information fusion technology has been applied in various fields, but the research on the fusion of target features is still rare in China, and there are many problems that need to be solved urgently. It is urgent to conduct in-depth research.

Overall design: Multi-sensor information fusion refers to the fusion of original target information acquired by multiple sensor groups with different properties such as infrared, visible light and laser radar. The first problem to be solved is to use different feature extraction algorithms for different sensors to extract the feature data of the target. Secondly, the fusion algorithm is used to fuse the target feature information into the composite feature information, and the classification recognition algorithm is used to identify the target process. The feature fusion target recognition system module can extract the valid feature data in the original target information and fuse it into the fusion feature information to be identified, thereby improving the recognition efficiency and the recognition accuracy.

Feature extraction: For infrared sensors, visible light, radar, etc., which detect multiple physical properties with different physical properties, the raw data of the target information they collect will also vary greatly, and the data information is huge. How to extract the feature information that the target has and can be effectively distinguished from other targets from many feature extraction algorithms is a problem that needs a lot of research and experiment to solve.

Feature fusion: Feature fusion algorithm refers to combining feature data of feature information. What is to be studied in feature fusion is which fusion method is adopted, which can achieve less and better data after fusion, and ensure the success and recognition of classification is fast and accurate. The fusion algorithm has the following two commonly used methods: serial feature fusion method and parallel feature fusion method. These optimization algorithms such as genetic algorithm and annealing algorithm can also be used for feature fusion, but the advantages and disadvantages are also obvious. The advantage is that the obtained fusion feature data is more refined. The disadvantage is that the fusion requires a lot of time and the design fitness function is needed.

Feature database: Whether the feature database is complete determines the correct rate and efficiency of target recognition. The target recognition algorithm needs to be compared with known patterns, that is, some parameters of the learning training algorithm. The known mode is to store the feature data of various targets in the feature database, then constitute a set of known patterns, and the target recognition classifier can be trained.

6. Conclusion

There are many steps in the existing information fusion, and it is usually very complicated. Each step of the whole fusion process requires a lot of manual intervention. At the same time, the information fusion process is very fragile. If the structure of one of the data sources in the fusion object changes, the entire fusion process needs to be redesigned. Multi-sensor fusion is an extremely uncertain technology that provides accurate test results. It is also an informatized and highly integrated intelligent data processing process that monitors industrial development, intelligent monitoring, military, and analytical images, robots, automatic recognition and other aspects have been greatly applied. The realization of fully controllable and self-automated information fusion of manual control and system autonomous has become a new expectation of users and a new challenge in the field of information fusion.

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