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Research on the Novel Multi-Data Fusion Methods in Wireless Sensor Networks

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Abstract: This paper discusses the new problems faced by multi-type data fusion, discusses the relationship available for fusion in multi-type data from the analysis of correlation, puts forward the concept of data type attribute correlation, and summarizes the research status of data fusion based on correlation. The general process of multi-type data fusion research is given, and the relevant literature is summarized according to the process. The model skillfully combines the hierarchical structure of wireless sensor networks and neural networks, and designs each cluster as a three-layer perceptron neural network model. The feature data is extracted from the large amount of raw data collected by the neural network method, and then the feature data is sent to the aggregation node.

Keywords: Multi-data fusion; wireless sensor networks

1. INTRODUCTION

As a new network system, wireless sensor network (WSN) has the characteristics of low cost, high precision and easy operation, which gradually highlights its position in science and technology. In wireless sensor network, a large number of sensor nodes continuously collect field data according to the set period, and these data have the following characteristics: (1) The data collected by a single sensor node many times in a short time has high similarity; (2) The data collected by the neighboring sensor nodes at the same time have high similarity. Data fusion is one of the important research fields in wireless sensor networks.

Using data fusion technology can effectively overcome the energy limitation in wireless sensor networks. By merging data from multiple data sources and removing redundant information, data fusion can effectively reduce the amount of data transmission in the network. In WSN applications, each node collects a large amount of sensing data. Suppose that in the wireless sensor network system, the node collects the humidity information of the surrounding soil environment every 30s, and generates 120 sensing data every hour, and 2880 sensing data will be generated in a day, The amount of data collected by nodes is very large

If multi-dimensional monitoring data is considered, the sharp increase in the amount of data transmitted by nodes will lead to the depletion of node energy, The sensing data of these nodes are highly similar or even the same in the physical type attributes expressed, so that the multi-source data has a certain degree of spatial correlation in the physical space. At the same time, due to the continuity of physical phenomena and the limitation of query operations in wireless sensor networks, the data values obtained by continuous sampling of nodes also have certain similarity, which is called time correlation. The research of data type attribute correlation is another important way following the research of time-space correlation.

Division of sensor nodes hops in network is shown below.

Effectively reduce the number of packets to reduce network energy consumption. This is a processing technology for source coding and the earliest data fusion technology. The NNBA model is designed for real-time monitoring applications, such as forest fire real-time monitoring network, large greenhouse monitoring network, etc. In this kind of application scenario, the sensor node continuously collects some environmental indicators, such as temperature, humidity, light intensity, and transmits the collected data to the sink node.

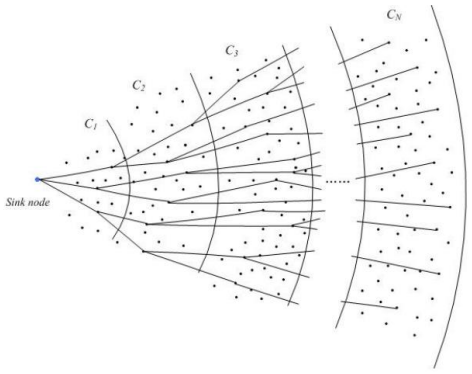

Figure. 1 Division of sensor nodes hops in network (image from Google)

2. THE PROPOSED METHODOLOGY

2.1 Correlation characteristics of multi-type data

First of all, data type attribute correlation is different from space-time correlation, and is a new correlation independent of space-time correlation. The correlation of monitoring data type attributes depends on the inherent attributes of the monitoring target's own type. The data type attributes are interdependent, converted or equivalent to each other. Krishnamachari and Estrin and other researchers have conducted in-depth research on the impact of data fusion technology in wireless sensor networks. The research results show that the impact of data fusion technology on the system is mainly manifested in two aspects: saving energy consumption and increasing delay time.

In fact, this is an irreconcilable contradiction. That is to say, data fusion can save energy consumption, but inevitably increase the delay time of data transmission. The data funnel is essentially a cluster-based data fusion. The boundary node is equivalent to the cluster head node, and the sensor node belongs to the intra-cluster node. The cluster head node is responsible for merging the data packets of the nodes in the cluster. The encoding algorithm based on data order can further compress the size of data packets. For formula (13), select the same Gaussian kernel function, and the induction data fitting curve is shown in Figure 2. When using formula (10) to approximate the data, there may be large deviation at the boundary or individual positions, because there may be no data associated with them when using the kernel method to calculate the weight value, The fitting results in the boundary region by using the local polynomial kernel regression method are good. The study of the correlation of data type attributes is another important way to follow the study of time-space correlation.

2.2 Energy model of sensor nodes

First of all, data type attribute correlation is different from space-time correlation, and is a new correlation independent of space-time correlation. The correlation of monitoring data type attributes depends on the inherent attributes of the monitoring target's own type. The data type attributes are interdependent, transformed or equivalent to each other. The traditional data fusion model is generally data fusion independent of data. There are nodes specially responsible for data fusion for data fusion, which is passive data fusion. Such data fusion is generally implemented during data transmission. This data fusion technology does not consider the correlation of data. After collecting the data, the node responsible for data fusion will sort out the collected data information and merge or discard some data with low reliability to reduce network energy consumption and improve data accuracy.

Neural network and data fusion have a common basic feature, that is, through certain operations and processing of a large number of data, we can get conclusive results that can reflect the characteristics of these data. Therefore, neural network can be used to realize and solve the problem of data fusion. Energy is an important resource in wireless sensor networks, and the main role of data fusion is to save energy. Therefore, it is very necessary to establish the energy model of sensor nodes and quantify the impact of data fusion on the energy of sensor nodes and the impact on the lifetime of wireless sensor networks.

By analyzing the correlation between the sampling points and the observed data, the induction data can be well approximated by linear regression. However, in practical problems, the relationship between the data is often not linear, and the direct use of linear regression model will fail. This requires selecting a relatively close curve to fit the data according to prior knowledge, and linearizing the nonlinear equation through transformation, Then the least square method is used to solve the linear regression equation. The data independent fusion algorithm generally includes two types of compression techniques, one is in the source coding.

3. CONCLUSION

This paper discusses the problems faced by current data fusion research, such as the complexity of data correlation redundancy and the difficulty of data fusion; The research status of data fusion is summarized; The concept of data type attribute correlation is proposed, which is independent of time-space correlation and has certain space-time characteristics. This paper points out that data prediction is an effective way to solve multi-type data fusion, data packet merging and model-driven data fusion. In practical applications, data fusion needs to be combined with MAC protocol, data-centric routing, network topology and other factors to conduct cross-layer design and optimization, so as to obtain the optimal energy benefits.

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