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**Low Cost and High Accuracy Data Gathering in WSNs with Matrix Completion**

**Abstract:**

Matrix completion has emerged very recently and provides a new venue for low cost data gathering inWireless sensor networks (WSNs). Existing schemes often assume that the data matrix has a known and fixed low-rank, which is unlikely to hold in a practical system for environment monitoring. Environmental data vary in temporal and spatial domains. By analyzing a large set of weather data collected from 196 sensors in ZhuZhou, China, we reveal that weather data have the features of low-rank, temporal stability, and relative rank stability. Taking advantage of these features, we propose an on-line data gathering scheme based on matrix completion theory, named MC-Weather, to adaptively sample different locations according to environmental and weather conditions. To better schedule sampling process while satisfying the required reconstruction accuracy, we propose several novel techniques, including three sample learning principles, an adaptive sampling algorithm based on matrix completion, and a uniform time slot and cross sample model. With these techniques, our MCWeather scheme can collect the sensory data at required accuracy while largely reducing the cost for sensing, communication and computation. We perform extensive simulations based on the data traces from weather monitoring and the simulation results validate the efficiency and efficacy of the proposed scheme.

**Existing System:**

In the traditional data gathering approach, a sensor node senses and sends data to a sink every time slot, which leads to a large amount of traffic and high sensing cost. Since the sensor nodes usually have limited computing ability and power supply, a primary goal of environment monitoring is to collect the sensory data at required accuracy with the least energy consumption.

To reduce the communication cost, some conventional methods have been proposed in WSN, such as distributed source coding techniques, in-network collaborative wavelet transform, and data aggregation. These methods exploit the spatial correlation in sensory data at sink or sensor nodes, but they may bring extra computational and communication overheads.

**Proposed System:**

We first analyze large traces of real weather data, and our study reveals that there exist hidden structures in the data. By taking advantage of these structures, we propose an on-line data gathering scheme based on matrix completion theory, named MC-Weather, which can adaptively sample different locations in response to changes in environment and weather conditions. We propose several novel techniques to well schedule the sampling process while satisfying the required accuracy for matrix reconstruction. Because only a subset of locations are sampled, our MC-Weather scheme can largely reduce the amount of traffic and computation cost.

Taking advantage of the relative rank stability feature, we propose three sample learning principles, based on which we propose an adaptive sampling algorithm to quickly find an effective set of samples to take while the complete measurement data are recovered from matrix completion.

To take the full advantage of our sample learning principle, we propose a Uniform Time-Slot and Cross Sample model (UTSCS). Compared with the Bernoulli model, we prove that our model ensures the matrix to have better features for higher matrix completion performance.

Through comprehensive simulations with real data traces, we show that our MC-Weather scheme can accurately acquire weather data at very low cost, which significantly outperforms the competing methods.