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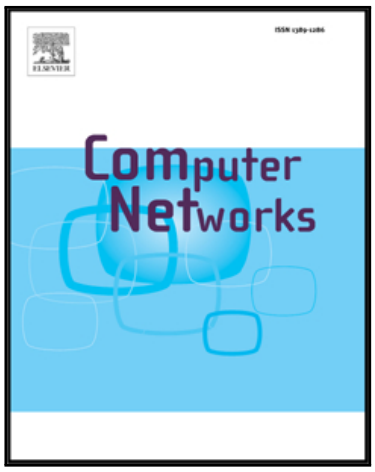

Probability Density Estimation in Sensor Networks Based on Distributed Mixture of Factor Analyzers, Mobile Agents and Stochastic Sensor Selection

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Probability Density Estimation in Sensor Networks Based on Distributed Mixture of Factor Analyzers, Mobile Agents and Stochastic Sensor Selection

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Abstract: This paper considers the problem of distributed probability density estimation of high-dimensional data in sensor networks. In order to describe and analyze high-dimensional observations, a mixture of factor analyzers can be used instead of Gaussian mixture model. Due to high communication costs between sensor nodes in centralized algorithms, use of these algorithms is not affordable. In this paper, a distributed estimation algorithm is presented based on the mixture of factor analyzers, mobile agents and stochastic sensor selection. In the proposed algorithm, at the beginning of each iteration, a mobile agent is assigned to each independent route of the network which consists of several sensor nodes based on a stochastic sensor selection scheme. The mobile agents calculate local sufficient statistics vector in each sensor node and update global sufficient statistics. At the end of each iteration, the parameters of the mixture model are computed by using global sufficient statistics. Convergence analysis of the proposed distributed algorithm is also presented. Finally, the performance of the proposed algorithm is evaluated by using numerical simulations. Simulation results show the promising performance of the proposed distributed algorithm.

Keywords: Sufficient statistics, distributed density estimation algorithm, sensor networks, mixture of factor analyzers.

1. Introduction

Sensor networks can be considered as one of the key technologies for the 21st century. A sensor network consists of sensing, computing and telecommunications components that can observe and respond to different events that occur in a given area. This kind of networks are used is a wide range of applications such as data collection, control, traffic systems, surveillance and military systems [1-4]. Today, several methods and techniques have been used to gather, store, organize and manage data efficiently and achieve meaningful results.

Data mining technique refers to the use of data analysis tools for extracting hidden information, patterns and specified relations in large volumes of data. These tools may be

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