Form 2

Dissertation Abstract

Report no.	No.252 (Dissertation-based)	Name	Miss. Nargis Parvin
Dissertation title	Blind Equalization for Wireless Sensor Networks （無線センサーネットワークのためのブラインド等化）		

Abstract

※ The abstract should be in keeping with the structure of the dissertation (objective, statement of problem, investigation, and conclusion) and should convey the substance of the dissertation.

Wireless sensor network (WSN) is a self-organized cooperative communication network composed by a number of geographically separated, autonomous sensor nodes with limited power and processing capability cooperating with each other to collect and process data from the surroundings. WSN cooperates through wireless transmission, to fulfill a common task. In recent years, WSN has attracted research interest because of its potential applications like battlefield surveillance, information gathering, precision agriculture, target detection, etc.

Two categories of estimation algorithm used in WSN as centralized and distributed estimation algorithm. In the centralized estimation algorithm, each sensor must communicate with the fusion center (FC) to reach the desired interest. It reduces the most valuable communication resources, energy, and bandwidth. On the other hand, the distributed estimation algorithm saves the communication resources utilizing the local observation and information derived from the neighboring sensor nodes. So far, there have been a number of distributed estimation algorithms to estimate the source transmission in digital communication. Most of the digital transmission of source information is accompanied by a phenomenon known as inter-symbol interference (ISI). This means that the transmitted pulses are smeared out so that pulses that correspond to different symbols are not separable. ISI has been recognized as the major obstacle to high-speed data transmission with the required accuracy and multipath fading over radio channels.

In this study, we concentrate on finding different distributed estimation algorithm that is useful for estimating the transmitted signal through the WSN model. It is well known that distributed processing techniques deal with the extraction of information from data collected at nodes that are distributed over a geographic area. Most of the existing distributed estimation algorithms are training based or non-blind. The training-based algorithms require the transmitted sequence as well as the desired signal as the training sequence at the receiver to estimate the unknown parameters. However, training-based algorithms have some drawbacks. The training signals are unavailable in most of the applications and may be unrealistic or impractical so that they reduce the data rate. Therefore, system efficiency and valuable channel capacity is reduced. In such cases, blind equalization is required, which does not need to know the transmitted

sequence. It uses only the received sequence and some a prior knowledge of the transmitted sequence statistics.

The objective of this thesis is to develop some approaches to improve the performance of the distributed blind estimation algorithms. In the conventional distributed blind estimation algorithms, each sensor node has specific equalizer and cooperating with each other by sharing information like equalizer output or the tap coefficient values of the equalizer. These distributed estimation algorithms are suffering from high computational complexity. Unlike these conventional distributed blind estimation algorithms, we utilize a simple method to estimate the transmitted sequence blindly which improves performance as well as reduced the computational complexity. Then, we focus on finding a solution to fix up the reason that degrades the performance of distributed estimation algorithms. In this case, a new approach has been proposed and implemented.

In this study, firstly we proposed a simple and unique normalized error based blind equalization method to estimate the transmitted signal in WSN. We consider a single-input-multiple-output (SIMO) channels-based static WSN model. Four cases of common channels or different channels and common variance of noises or different variance of noises are considered and set out a solution for every case.

For different channel cases, we derive a new approach for finding the best sensor output by implementing the adaptive normalized error and utilize the generalized Sato equalizer (GSA) to estimate the transmitted signal blindly from the best sensor output. The simulation results showed that the effectiveness of the proposed method for improving the performance with the shortest computational complexity.

The second method proposes a new approach to tackle the problems arise in the distributed blind estimation algorithms when different channel output signals severely affect the transmitted signal and the performance is deteriorated. We design a new combination rule here for the further improvement utilizing the most important channel characteristics eigenvalue spread. Eigenvalue spread is the ratio of maximum and minimum eigenvalues of the input autocorrelation matrix of the transmitted signal. There are a number of combination rules for the distributed estimation algorithm in which the weights are derived considering only the number of neighbors of each sensor node. Nevertheless, we consider the channel characteristics which is the special constraint of the distributed estimation algorithms for deriving weights of the combination rule. This method gives larger weight values to those nodes which have smaller eigenvalue spread value and smaller weights to those nodes which have larger eigenvalue spread value. As a result, the more severe channel output signals are almost ignored in the distributed blind estimation. Any of the distributed estimation algorithm with proposed combination rule gives better performance.