Channel Equalization for QAM Signal Constellation Using Wavelet Transform and Neural Network

Seok Won Lee* and Boo Hee Nam**

* Dept of Control & Instrumentation Engineering, Kangwon National University, Chunchon, Korea
(Tel : 82-33-243-4347; Fax : 82-33-242-2059 ; E-mail:seokwon@can.kangwon.ac.kr)
** Dept of Electrical and Computer Engineering, Kangwon National University, Chunchon, Korea
(Tel:82-33-250-6341; Fax : 82-33-242-2059 ; E-mail:boonam@kangwon.ac.kr)

Abstract

Recently, a considerable amount of attention is being given to the use of wavelets and neural network for modulation and equalization. We proposed a new scheme of equalization for constellation using discrete wavelet transform(DWT) and neural network. The DWT is used for noise reduction and the neural network is used to update the equalizer coefficients adaptively.

1. Introduction

In modern digital communication, channel equalization plays an important role in compensating for channel distortion. Unfortunately, most channels have time-varying characteristic, i .e., their transfer functions change with time. Therefore, adaptive equalizers have been applied in order to cope with these issues. In [3],
Patra *et al.* reported that the adverse effects of the dispersive channel causing intersymbol interference (ISI), the nonlinearities introduced by the modulation/demodulation process, and the noise generated in the system, are to be suitably compensated for.

Also the performance of the linear channel equalizers employing a linear filter with FIR and using a least mean square or recursive least-squares algorithm is limited specially when the nonlinear distortion is severe. In such cases, artificial neural networks can perform complex mapping between its input and output space and are capable of forming complex decision regions with nonlinear decision boundaries[3],[6],[8].

In [2], they presented an equalization algorithm for a wavelet packet-based modulation scheme. A nonideal channel can be divided into a set of bands, where each band can be approximated as a simple attenuation and delay channel. If the data sequence is used to modulate a set of wavelet packets, the equalization problem reduces to that of determining the delay introduced by the channel for each of the wavelet packets and possibly a change of sign in the decoded symbols.

In [4], Tzannes *et al.* introduced a new channel coding technique that utilizes the orthogonality inherent in multiplier coefficients matrix. The benefits of this algorithm are its simple decoding process and its coding gains in fading and burst noise communications channels.

In this paper, we present new scheme of channel equalizer for digital communication system. We added a discrete wavelet transform block into the general scheme of channel equalizer for noise reduction. Also, neural network is used for equalizer of the system. We show that the wavelet transform modulation can reduce the burst noise of communication system.

2. Proposed communication system

It is shown that the general scheme of channel equalizer in Fig. 1.

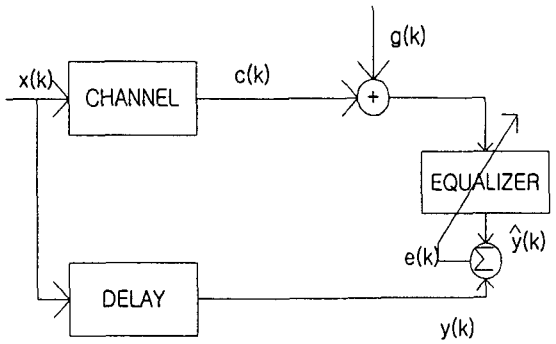

Fig. 1. General scheme of channel equalizer.

For high-speed digital data transmission over a