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Comparison of Performance of Adaptive Channel Equalizer using LMS, RLS, KALMAN Algorithm- A Review

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Abstract

In non-ideal communication channel, signal quality fades with distance. Moreover, effect of multipath propagation causes transmitted signal to be attenuated, superimposed and delayed at receiver in practical communication channel, causes Inter Symbol Interference (ISI). This ISI is overcome using Channel Equalizer and technique used is Equalization. In digital communication, Adaptive Equalizer which automatically adapts to time-varying properties (parameters) of communication channel. Equalizer is adaptive i.e. its weights are adjusted itself according to the input signals. Adaptive Algorithms such as LMS, RLS and KALMAN are used in digital processing applications.

Keywords: LMS (Least Mean Square), RLS (Recursive Least Square), MATLAB

1. Introduction

The requirement is to design a reliable system so that data is transmitted at higher rate. ISI and thermal noise affect the data in channel. When designing optical receiver in various applications, receiver filter requires functions which can estimate the interference. Interference statistics should be known a priori for filter design. Adaptive filter adaptively estimate the interference. Adaptive algorithm can be applied in any application where an adaptive filter may be needed. In LMS algorithm, both converges speed and residual error level are decided using step size. RLS algorithm has fast converges and high complex operations per sample. KALMAN filter has good performance in quality of estimation but high complexity in operation. Touch screen devices where on typing passwords is not more secure, especially for secure internet applications.

In early system only text password is used which is very difficult to remember if enter a long password. If we use smaller password then it can be easily identify and we also use common password for many accounts so for that Image based Captcha provide more security during authentication

2. Algorithms of adaptive channel equalizer

The different adaptive algorithms used for designing channel equalizer in this thesis are

- LMS algorithm
- RLS algorithm
- Kalman algorithm

LMS algorithm uses the estimates of the gradient vector from the available data. LMS incorporates an iterative procedure that makes successive corrections to the weight vector in the direction of the negative of the gradient vector which eventually leads to the minimum mean square error.

RLS algorithm is adaptation algorithms are based on the exact minimization of least-squares criteria. The filter weights are optimal at each time instant n. Adaptive RLS algorithms are the time-recursive analogs of the block processing methods of linear prediction and FIR Wiener filtering.

KALMAN Algorithm is an algorithm that uses a series of measurements observed over time. The algorithm works in a two-step process. In the prediction step, the Kalman filter produces estimates of the current state variables, along with their uncertainties. Once the outcome of the next measurement is observed, these estimates are updated using a weighted average.

3. Related work

B. Rohani et. al. [1994]: This paper presents a modified LMS algorithm which has greater convergence. The Weighted Step Size (WSS) Least Mean Squares (LMS) algorithm utilizes non-uniform step sizes for updating an impulse response estimator..

Kensaku Fujii and Juro Ohga et. al. [1997]: This paper proposes a new type of adaptive algorithm which is derived from a first order infinite impulse response (IIR) filter expression of the normalized least mean square (NLMS) algorithm.

Inseop Lee et. al. [1997]: This paper presents the design of an experimental ASIC for an all-digital adaptive equalizer for magnetic channels.

Jeffrey C. Strait et. al. [1997]: This paper examines techniques to improve both the rate of error convergence of the adaptive equalizer and the residual ISI of the system.

Joshua C. Park et. al.[1999]: In this paper, Fully adaptive continuous-time Infinite Impulse Response (IIR) equalizer topologies for use in magnetic recording read channels are presented.

Zhi Ding [2000]: Using the standard least mean LMS algorithm, an adaptive equalizer is a finite-impulse-response FIR filter whose desired reference signal is a known training sequence sent by the transmitter over the unknown channel.

Kari Hooli et. al. [2001]: In this paper, four adaptive versions of chip-level channel equalizers are studied and their performance is evaluated in a Rayleigh fading multipath channel.

Minglia JIN et. al. [2004]: In this paper, a new computationally efficient algorithm for recursive least-squares (RLS) algorithm called Reduced Order RLS, also called as Partial Updating RLS (PU-RLS), algorithm is introduced.

K.Deergha Rao et. al. [2006]: In this paper, it is shown that the single-input multi-output (SIMO) FIR second Volterra channels can be equalized using the linear combination of channel outputs and input.

H. C. Song et. al.[2006]: This paper demonstrates that using multilevel quadrature amplitude modulation (M-QAM) in shallow water.

Yong-Hua Cheng et. al. [2007]: The paper is focused on the DSRC baseband technical analysis and the application development.

Li Yan et. al.[2007]: In this paper, several VS LMS algorithms are reviewed and a modified VS LMS algorithm is proposed.

Yuriy Zakharovt et. al .[2007]: In this paper, Fast RLS algorithm using dichotomous coordinate descent iterations is introduced.

A.A.H. Ab-Rahman et. al. [2008]: This paper presents the design of adaptive equalizer as applied in wireless systems as to achieve error proof data communication

Susmita Das et. al. [2008]: This paper proposes a RNN model non linear IIR system.

Junfeng Wang et. al. [2009]: This paper presents a variable forgetting factor RLS algorithm

Mohammad E. Mousa Pasandi et. al. [2009]: In this paper, the performance of an adaptive weighted channel equalizer for non-compensated OFDM transmission systems is studied.

Mahmood Farhan Mosleh et. al. [2010]: In this paper, a new combination of RLS and LMS is presented by partitioning the main frame of data into subsequent frames.

4. Proposed work

In my research work, different models are prepared using input signal random integer to show that the equalizer is adaptive i.e. its weights are adjusted itself according to the input signal. The models are prepared using different algorithms to make a comparative study of different algorithms. These algorithms are compared by comparing the outputs of different models.

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