Multi ~~V~~variable Optimization Approach for Power Allocation in OFDM-DCSK System

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ABSTRACT

This paper proposes some multi-variable approaches ~~to~~ for power allocation in (OFDM-DCSK) system. The objective is to minimize the overall Bit Error Rate (BER) under the total transmission power limit. There ~~are~~ is some literature focusing on the power allocation for OFDM-DCSK systems, but all of them have only addressed the case where the power allocated to the reference sub-carrier is assumed ~~a~~ fixed ~~value for~~to simplify the problem to a single-variable optimization problem. In this paper, we simultaneously take the reference and data-bearing subcarriers power into consideration. Firstly, we formulate a multi-variable optimization problem and solve it using Lagrange relaxation to derive a closed form solution. Secondly, we solve the problem using a genetic algorithm-based approach and determine ~~the~~ its complexity level ~~of it~~ in terms of the number of generations and the number of initial population for AWGN channel, and then develop it for use in ~~the~~ a frequency selective fading channel. The ~~S~~simulation results ~~show~~ indicate that both of the proposed approaches outperform algorithms ~~with~~ relaxing the reference power in terms of the BER performance, but the analytical solution leads to ~~a less~~less time complexity in comparison with the GA-based method.

1. INTRODUCTION

In recent years, chaos-based communication has been widely studied ~~because~~ as chaotic signals are non-periodic, deterministic, wideband, noise-like, and more difficult to predict [1]. Also, several coherent and non-coherent chaos-~~-~~based modulation schemes ~~were~~ have been ~~evolved~~ developed in the literature [2-5]. The non-coherent chaotic modulations such as Differential Chaos Shift Keying (DCSK) [6] are easy to implement and have an inherent robustness to multipath propagation. More importantly, the DCSK demodulator needs no channel estimator at the receiver side [7]. In DCSK modulation, a portion of the chaotic signal (reference part) is transmitted followed by its inverted or non-inverted version (information-bearing part) depending on the bit of information. ~~At~~ On the receiver side, the reference signal and information-bearing signal are correlated ~~and~~ whereby the information is extracted. In order to improve the Bit Error Rate (BER) performance and energy efficiency ~~of~~ the DCSK modulation, Multi Carrier DCSK (MC-DCSK) scheme ~~is~~ has been proposed in [8].

On the transmitter side of the MC-DCSK, ~~number~~ M number of data bits spread ~~by~~ via multiplication in time domain ~~with~~ by ~~a~~ chaotic spreading code ~~and~~ with each of them being transmitted via M data-bearing sub-carriers. Here, one subcarrier is adopted ~~to~~ for transmitting the chaotic spreading code as a reference signal. In [9], the authors proposed the orthogonal frequency division multiplexing-based DCSK (OFDM-DCSK) system. In the OFDM-DCSK design, inspired by comb-type pilot pattern, the reference signals are distributed among data-bearing subcarriers. In the OFDM-DCSK system, all of the ~~used~~ utilized subcarriers are ~~grouped~~ categorized into ~~a~~ several groups and in each of the groups, one subcarrier is assigned to transmit the reference signal, while the other subcarriers serve as data-bearing signals. Fig. 1, ~~shows~~ reveals an example of a