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On the Error Rate of Coherent Binary Modulation Techniques in Mobile Communication Systems over Generalized Fading Channels Impaired by Generalized Gaussian Noise

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***Abstract*—In the this paper, the performance of coherent binary digital modulation techniques is investigated. Specifically, we derive exact closed-form expressions for the average bit error rate (BER) of coherent binary phase shift keying (BPSK) and frequency shift keying (BFSK) in the α-μ fading channels impaired by generalized Gaussian noise. The derived expressions take into account the mobility of the wireless receiver. In this paper, we employ the random waypoint (RWP) model to study the effect of mobility on the system performance. Some representative analytical results are presented to investigate the effects of the fading parameters, noise shaping parameter, and network topology on the system performance. In addition, Monte-Carlo simulations are provided to validate the accuracy of the analytical results.**

***Index Terms*—BER, fading channels, non-Gaussian noise, RWP.**

I. Introduction

Over the past years, the performance of various wireless communication systems over different fading channels has been investigated. In [1], the authors derived general and simple closed-form expressions for the probability density function (pdf) and cumulative distribution function (cdf) of the composite α-μ /α-μ fading distribution. Besides, the authors showed that the α-μ/α-μ distribution is analogues to the extended generalized-K distribution (EGK), where each distribution can be deduced from the other through simple relations. Kumar and Chouhan considered a decode-and-forward relay based dual-hop spectrum-sharing network operating over composite κ-μ shadowed fading channels [2]. The authors analyzed the system in terms of outage probability and ergodic capacity. In [3], the authors derived a simple envelope correlation expression of two maximal-ratio combined (MRC) signals in correlated diversity Rician-fading channels in high signal-to-noise ratios (SNRs) regime. Ying et al. developed a blind particle learning detector (BPLD) for signal detection in Rayleigh flat-fading channels with impulsive noise interference [4]. The authors assumed that the parameters of the fading channel model and the noise model are all unknown and the impulsive noise can be modeled as a mixture of Gaussian distributions. In [5], the authors proposed a wide-band quadrature amplitude modulation (QAM) receiver based on the decision feedback equalize (DFE) structure to further enhance the received bit error rate (BER) in a time varying multi-path fading channels. In [6], the authors analyzed the performance of digital communication systems over the α-η-μ fading channels subject to additive Gaussian noise. Specifically, exact close-form expressions for the average channel capacity and the average symbol error probability (SEP) for several coherent and non-coherent modulation schemes are derived and evaluated.

The performance of the α-μ fading channels in different communication systems is analyzed in [7–13]. In [7], the authors derived exact closed-form expression for the average BER for M-ary quadrature amplitude modulation (M-QAM) over the α-μ fading channels with additive white generalized Gaussian noise (AWGGN) in multi-hop wireless communication system with decode-and-forward (DF) relays. The performance of BER for adaptive transmission with selection combining (SC) diversity is examined in [8]. In [9, 12], the authors analyzed the performance of the average bit error rate (BER) for binary phase shift keying (BPSK) and frequency shift keying (BFSK) in the α-μ fading channels based on the moment generating function (MGF) technique. Darawsheh and Jamoos derived closed-form mathematical expression for the average probability of detection of the energy detector (ED) over α-μ generalized fading channels with SC diversity reception [10]. The performance of average channel capacity for different transmission policies over the α-μ fading channel is investigated in [11, 13].

In the literature, the performance of different types of wireless communication systems over the α-μ generalized fading channels consider only static network (i.e., no mobility). Thus, our aim in this paper is to study the performance of wireless mobile communication systems over the α-μ fading channels impaired by AWGGN. To this end, in this paper we derive new and exact closed-form expressions for the average BER of coherent binary digital modulation schemes namely, BPSK and BFSK. The derived expressions take into consideration static and mobile receiving nodes. The mobility of the receiving nodes is modeled by the well-known random waypoint (RWP) mobility model, which is widely used in the literature to model the mobility of the nodes in the network. Also, the obtained expressions are valid for integer and non-integer values of the fading parameters, α and μ, and the shaping noise parameter λ.

The remainder of this paper is organized as follows. Section II describes the system and channel models. Section III derives the average BER of coherent binary digital modulation schemes for the system under consideration. Some representative numerical results are discussed in Section IV. Finally, Section V concludes this letter.

II. System and Channel Models

In this paper, we consider a typical single input single output (SISO) communication system. As such, the received signal Y can be modeled as [14]

$$Y = Hs + Z, \tag{1}$$

where $H \in \mathbb{R}^+$ is the channel fading envelope, s is the transmitted signal, and $Z \in \mathbb{R}$ is an AWGGN with with zero mean, variance σ^2.

In this paper, we assume that the full channel state information (CSI) is known at the receiver side. The fading envelope H

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