Closed Form Expression of Nakagami-like Background Noise for Power Line Communication

Kim Young Sun, Choi Sungsoo, Oh Hui-Myoung, Lee Jae-Jo
Korea Electrotechnology Research Institute (KERI)
yskim@keri.re.kr

전력선 통신에서 나카가미 배경 잡음에 관한 연구

김영선, 최성수, 오휘명, 이재조
한국전기연구원

Abstract

Power line channel is the most powerful solution for backbone network in home while it is difficult to model its nature exactly due to hardly predictable parameters such as noise, impedance and attenuation. Using the recent work that the amplitude distribution of background noise can be modeled as a Nakagami distribution, we derive and present *real portion of the closed-form background noise probability density function without any integration. This work will* remove obstacles on the way to analysis of system performance, receiver design, effects of imperfect assumption for system parameters in power line communication.

1. Introduction

Power line communication(PLC) has been used home automation and control of power utilities and facilities with low rate data transmission. Recently, PLC broadens its coverage to high speed broadband communication network. About 200Mbps data transmission in physical layer is possible using 1~30MHz bandwidth[1].

Power line channel itself is a very tough, noisy and nonlinear transmission medium and its characteristic depends heavily on measuring time, site, residential structure, electrical facilities and other environmental parameters[2]. This fact discriminates power line channel from wireless channel or other wired channel. Thus many researchers devoted themselves to channel parameters such as noise, impedance, attenuation and etc[3-4].

Noise of power line channel can be categorized background noise and impulsive noise. The former one is relatively low noise like additive white Gaussian noise in wireless channel, the latter comes from diverse electrical appliances with considerably large noise power.

Recently, the amplitude distribution of the background noise with single frequency has been modeled as a Nakagami distribution after long-term measurements[5]. In [5], real portion of background noise is determined by expression of integration and evaluated approximated power series.

In this paper, we derive an closed-form expression for real portion of background noise without integration and approximation. This work will contribute to the exploration of the effects of the background noise on PLC modulation and performance. This paper is organized as follows. Background noise model is presented in Chapter 2. In Chapter 3, we derive closed-form probability density function (PDF) for background noise. The simulated and analyzed results are compared in Chapter 4. Finally, we conclude this paper in Chapter 5.

2. Background Noise Model for Power Line

In [5], the background noise amplitude at a single frequency follows the Nakagami-m distribution. Since we need to know real portion of noise like Gaussian noise from Rayleigh amplitude