This Thesis is Dedicated to

My Mother

Smt. Kalpeshwari Devi

Declaration

I hereby declare that the work presented in this thesis entitled *Physical Layer Security and Performance Evaluation of Power Line Communication Systems* submitted to the Indian Institute of Technology Jodhpur in partial fulfillment of the requirements for the award of the degree of Doctor of Philosophy, is a bonafide record of the research work carried out under the supervision of Dr. Aashish Mathur. The contents of this thesis in full or in parts, have not been submitted to, and will not be submitted by me to, any other Institute or University in India or abroad for the award of any degree or diploma.

Vinay Mohan
P18EE003

Certificate

This is to certify that the thesis titled *Physical Layer Security and Performance Evaluation of Power Line Communication Systems*, submitted by *Vinay Mohan (P18EE003)* to the Indian Institute of Technology Jodhpur for the award of the degree of *Doctor of Philosophy* is a bonafide record of the research work done by him under my supervision. To the best of my knowledge, the contents of this thesis, in full or in parts, have not been submitted to any other Institute or University for the award of any degree or diploma.

Aashish Mathur
Ph. D. Thesis Supervisor

After studying the secrecy performance of the considered PLC system, this dissertation further evaluates the performance of the PLC systems under random pulse jamming attacks assuming M-ary phase shift keying modulation (MPSK). Herein, the PLC channel is assumed to follow Log-normal channel gain and the Bernoulli-Gaussian random process describes the nature of PLC noise. Additionally, the state of the jammer is characterized by the Bernoulli random variable. Conditioned upon the jamming activity, we evaluate the probability density function (PDF) of the instantaneous signal-to-jamming-plus-noise ratio (SJNR) and the instantaneous signal-to-noise ratio (SNR). Capitalizing on the statistical characterization of the SJNR and SNR, we derive the series-based expressions of the average symbol error rate (ASER) and outage probability (OP) for the considered PLC system. Further, the asymptotic ASER analysis is performed in terms of the coding gain and diversity order in the high SNR regime. In order to gain more insights into ASER and OP analysis of the considered PLC system, we demonstrate the effect of the different system parameters through the numerical results.

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Vinay Mohan

List of Abbreviations

ABER	Average Bit Error Rate
AES	Advanced Encryption Standard
ASC	Average Secrecy Capacity
ASER	Average Symbol Error Rate
AWGN	Additive White Gaussian Noise
BB	Broadband
BER	Bit Error Rate
bps	Bits Per Second
CDF	Cumulative Distribution Function
CSI	Channel State Information
CSK	Chaos Shift Keying
DCSK	Differential Chaos Shift Keying
DoS	Denial-of-Service
DS-CDMA	Direct Sequence Code Division Multiple Access
DS-DPSK	Direct Sequence Differential Phase Shift Keying
DS-MDPSK	Direct Sequence M-ary Differential Phase Shift Keying
DSP	Digital Signal Processing
EMI	Electromagnetic Interference
EVs	Electric Vehicles
FCC	Federal Communications Commission
FGM	Farlie-Gumbel-Morgenstern
HAN	Home Area Networking
HDR	High Data Rate
ICT	Information and Communication Technology
IID	Independent and Identically Distributed
IoT	Internet of Things
Kbps	Kilobits Per Second
KPIs	Key Performance Indicators
LDR	Low Data Rate
LV	Low-Voltage
Mbps	Megabits Per Second
MIMO	Multi-Input Multi-Output
MV	Medium Voltage
NB	Narrowband
OP	Outage Probability
PDF	Probability Density Function
PLC	Power Line Communication
PLS	Physical Layer Security
PRIME	Powerline Intelligent Metering Evolution
PSD	Power Spectral Density
QoS	Quality-of-Service
QPSK	Quadrature Phase Shift Keying
RSA	Rivest, Shamir, Adleman

RV	Random Variable
SCR	Secrecy Coverage Region
SISO	Single-Input Single-Output
SJNR	Signal-to-Jamming-Plus-Noise Ratio
SOP	Secure Outage Probability
SPSC	Strictly Positive Secrecy Capacity
UNB	Ultra-Narrowband
US	United States
VLSI	Very Large-Scale Integration

List of Symbols

A	Alice
β	Spreading factor
M	Bob
$\mathbb{C}_{\mathfrak{f}}$	Copula density function
$\mathcal{G}_{\mathrm{c}}$	Coding gain
$\mathcal{C}_s$	Instantaneous secrecy capacity
$\mathcal{D}_l$	DCSK modulated symbol
$\mathcal{D}_{\mathrm{o}}$	Diversity order
$\exp(\cdot)$	Exponential
δ	Attenuation
E	Eavesdropper
$\mathrm{erfc}(\cdot)$	Complementary error function
$\mathbb{E}[\cdot]$	Expectation operator
$\Gamma(.)$	Gamma function
$\bar{\gamma}_M$	Average power of the main channel
γ_{th}	Threshold signal-to-noise ratio
$G_{p,\,q}^{\,m,n}\left(x\middle\vert\begin{smallmatrix}\cdots\\ \cdots\end{smallmatrix}\right)$	Meijer's G function
n	Noise
N_J	Net jamming power
$\mathcal{N}(\cdot,\cdot)$	Gaussian distribution
p	Probability of arrival of the impulsive noise
μ	Mean
σ	Variance
$\mathcal{P}_{\mathrm{tx}}$	Probability of transmission
${}_pF_q(\cdot;\cdot;\cdot)$	Generalized Hypergeometric function
P_B	Bernoulli random variable
P_J	Average jamming power
$\Pr(\cdot)$	Probability
K	Impulsive noise index
P_T	Transmitted power
P_L	Path loss
$\mathcal{R}_{\mathrm{th}}$	Threshold rate
ρ	Correlation coefficient
$\mathcal{S}_j$	Jamming modes
θ	Dependence parameter
τ	Secrecy throughput
ϕ	Jamming Probability
$\Psi(\cdot;\cdot;\cdot)$	Tricomi's function
$\mathcal{Q}(\cdot)$	Gaussian $\mathcal{Q}$ function
$(W)_w$	Pochhammer symbol
!	Factorial operation

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