

Fading and Shadowing in Wireless Systems

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*Dedicated to my mother Kanakabai
and late father N. Padmanabharao*

Preface

During the past two decades there has been a substantial growth in research in wireless communications. The number of journals published from various parts of the world catering to the research community has grown exponentially. Despite such a growth, the engineering community still needs more information so as to thoroughly comprehend wireless channel characteristics. What specifically must be understood are the effects of channel degradation brought on by statistical fluctuations in the channel. This must be grasped fully and comprehensively before successful attempts can be made to mitigate the channel impairments. Such statistical fluctuations do manifest as variations in signal powers, which are observed in the channel generally modeled using a variety of probability distributions, both in straight forms as well as in compound forms. While the former might explain some of the effects, the latter, namely, the compound models, which incorporate both short-term and long-term power fluctuations in the channel, help explain the much more complex nature of the signals in these channels. Often, we see newer and more powerful models being proposed, presented, and tested to see how they fit the observed power fluctuations.

This book addresses the needs of graduate students and instructors who are exploring the various aspects of power fluctuations, which are generally expressed in terms of fading, shadowing, and shadowed fading channels. This work grew out of the author's studies and explorations during a two-quarter sabbatical (September 2009–March 2010) granted by Drexel University. The chapters are based on both my teaching and research into the statistical aspects of wireless channels. Specifically, this work focuses on the analysis and study of several models currently available in the literature of wireless communications (books, archival journals, and conference proceedings). This expansive research describes the statistical characteristics of the signals that account for the fading, shadowing, and shadowed fading seen in these channels. The book is not intended as a catalog or encyclopedia of fading and shadowing. Indeed, the thrust of the book is a pedagogical approach to the topics of fading and shadowing. It provides insight into the modeling and analysis of fading and shadowing. Starting with statistical background and digital

communications, the chapters are formulated to follow the details of modeling of the statistical fluctuations of signals in these channels. The degradations in the channels arising from the statistical fluctuations are quantitatively described in terms of various measures. This is followed by the discussion of diversity and associated signal processing algorithms that mitigate the effects of statistical fluctuations in the channel and the quantitative measures of improvements brought on by diversity. The book also examines the effects of interference from other channels. It is my expectation that this work will provide an in-depth and unique coverage of topics for graduate level study in wireless communications.

The book would not have been possible without the full support of my wife Raja and our daughter Raji. Besides reading the early drafts of the chapters, they provided insights into chapter organization and pointed out the need for further explanation. Their efforts made it possible to complete the project in a reasonable period; I am proud to say that the book has been a family project.

I am very grateful to our friend Ms. Maura Curran who graciously agreed to proof read the chapters on very short notice, despite having a full workload as compositor and editor.

I thank my editor Mr. Brett Kurzman. Without his enthusiastic support, this work could not have been undertaken. The support provided by Springer, particularly Mr. Brian Halm and his colleagues in New York and Mr. D. Raja and his team at SPi Global is acknowledged. I also extend my grateful appreciation to Drexel University for their support and cooperation.

Philadelphia, USA

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Contents

1	Overview	1
1.1	Outline	1
	References	5
2	Concepts of Probability and Statistics	7
2.1	Introduction	7
2.2	Random Variables, Probability Density Functions, and Cumulative Distribution Functions	8
2.3	Characteristic Functions, Moment Generating Functions and Laplace Transforms	10
2.4	Some Commonly Used Probability Density Functions	11
2.4.1	Beta Distribution	11
2.4.2	Binomial Distribution	13
2.4.3	Cauchy Distribution	15
2.4.4	Chi-Squared Distribution	16
2.4.5	Erlang Distribution	18
2.4.6	Exponential Distribution	18
2.4.7	F (Fisher-Snedecor) Distribution	20
2.4.8	Gamma Distribution	21
2.4.9	Generalized Gamma Distribution	22
2.4.10	Inverse Gaussian (Wald) Distribution	26
2.4.11	Laplace Distribution	27
2.4.12	Lognormal Distribution	28
2.4.13	Nakagami Distribution	30
2.4.14	Non-Central Chi-Squared Distribution	32
2.4.15	Normal (Gaussian) Distribution	33
2.4.16	Poisson Distribution	35
2.4.17	Rayleigh Distribution	36
2.4.18	Rectangular or Uniform Distribution	38

2.4.19	Student's t Distribution	39
2.4.20	Weibull Distribution	41
2.5	Joint, Marginal and Conditional Densities	43
2.6	Expectation, Covariance, Correlation, Independence, and Orthogonality	44
2.7	Central Limit Theorem	46
2.8	Transformation of Random Variables	47
2.8.1	Derivation of the pdf and CDF of $Y = g(X)$	47
2.8.2	Probability Density Function of $Z = X + Y$	50
2.8.3	Joint pdf of Functions of Two or More Random Variables	51
2.8.4	Use of CHF to Obtain pdf of Sum of Random Variables	57
2.8.5	Some Transformations of Interest in Wireless Communications	58
2.9	Some Bivariate Correlated Distributions of Interest in Wireless Communications	73
2.9.1	Bivariate Normal pdf	73
2.9.2	Bivariate Nakagami pdf	75
2.9.3	Bivariate Gamma pdf	76
2.9.4	Bivariate Generalized Gamma pdf	77
2.9.5	Bivariate Weibull pdf	78
2.9.6	Bivariate Rician Distribution	79
2.10	Order Statistics	79
2.10.1	A Few Special Cases of Order Statistics in Wireless Communications	82
2.11	Decision Theory and Error Rates	85
2.11.1	Gaussian Case	86
2.11.2	Non-Gaussian Case	90
2.12	Upper Bounds on the Tail Probability	94
2.12.1	Chebyshev Inequality	94
2.12.2	Chernoff Bound	96
2.13	Stochastic Processes	97
2.14	Summary	102
	References	102
3	Modems for Wireless Communications	109
3.1	Introduction	109
3.2	Optimum Receiver, Pulse Shaping, and Nyquist's Criteria	110
3.3	Efficiency of Digital Modulation Techniques	117
3.4	Geometric Representation of Signals and Orthonormal Functions	118
3.5	Modulation Techniques	121
3.5.1	Amplitude Shift Keying	121
3.5.2	Phase Shift Keying	122

3.5.3	Frequency Shift Keying.....	124
3.5.4	Amplitude and Phase Shift Keying.....	125
3.5.5	Limitations of BPSK and Justification for MPSK.....	127
3.6	General Nonlinear Modulation Schemes.....	141
3.6.1	Frequency Shift Keying.....	141
3.6.2	Digital Frequency Modulation (DFM) and Minimum Shift Keying (MSK).....	142
3.6.3	Gaussian Minimum Shift Keying.....	146
3.6.4	Orthogonal M-ary FSK.....	147
3.6.5	Error Rates for MSK, OQPSK, $\pi/4$ QPSK, and GMSK.....	151
3.7	Error Rates for Differentially Encoded Signals.....	151
3.8	Orthogonal Frequency Division Multiplexing.....	159
3.9	Summary.....	163
	Appendix.....	163
	References.....	187
4	Modeling of Fading and Shadowing.....	193
4.1	Introduction.....	193
4.2	Background.....	194
4.3	Models for Short-Term Fading.....	196
4.3.1	Rayleigh Fading.....	197
4.3.2	Rician Fading.....	201
4.3.3	Nakagami Fading.....	206
4.3.4	Gamma, Generalized Gamma, and Weibull Fading.....	211
4.4	Models for Shadowing.....	215
4.5	Models for Shadowed Fading Channels.....	218
4.5.1	Nakagami-Lognormal Models.....	218
4.5.2	Nakagami-Gamma or Generalized K Models.....	220
4.5.3	Nakagami-Inverse-Gaussian Model.....	221
4.5.4	Generalized Gamma Model.....	223
4.5.5	Amount of Fading in Shadowed Fading Channels.....	225
4.6	Composite Model for Fading, Shadowing, and Shadowed Fading.....	226
4.7	General Cascaded Models.....	231
4.7.1	Statistical Background of Cascaded Fading Channels.....	232
4.7.2	Cascaded Approach to Shadowed Fading Channels.....	236
4.7.3	N *Weibull Channels.....	245
4.7.4	Double Rician Channels.....	245
4.8	Comparison of Different Models.....	246
4.8.1	Average Probability of Error.....	247
4.8.2	Outage Probability.....	262
4.9	Other General Fading Models.....	273
4.10	A few Additional Quantitative Measures of Fading and Shadowing.....	283

4.10.1	Ergodic Channel Capacity	284
4.10.2	Second Order Statistics of Fading, Shadowing, and Shadowed Fading Channels.....	290
4.11	Summary	298
	Appendix	299
	References.....	308
5	Diversity Techniques	313
5.1	Introduction	313
5.2	Concept of Diversity	314
5.2.1	Space Diversity.....	317
5.2.2	Frequency Diversity.....	318
5.2.3	Polarization Diversity	318
5.2.4	Time Diversity	319
5.2.5	Multipath Diversity	320
5.3	Diversity Combining Algorithms	321
5.3.1	Selection Combining.....	321
5.3.2	Maximal Ratio Combining.....	322
5.3.3	Equal Gain Combining.....	324
5.3.4	Preliminary Comparison of the Three Combining Algorithms.....	324
5.3.5	Selection Combining and Switched and Stay Combining	329
5.3.6	Effects of Branch Correlation on Combining Algorithms	334
5.4	Shadowing Mitigation and Macrodiversity.....	340
5.5	Macro- and Microdiversity Systems (Hybrid Diversity).....	343
5.6	Generalized Selection Combining	353
5.7	Quantitative Comparison of Diversity Combining Algorithms	361
5.7.1	Amount of Fading.....	362
5.7.2	Average Probability of Error.....	366
5.7.3	Outage Probability	379
5.8	Diversity in Generalized Gamma and Weibull Channels	385
5.9	Diversity in Cascaded Nakagami Channels	395
5.10	Generalized Selection Combining.....	408
5.11	Summary.....	410
	References.....	411
6	Interference in Wireless Channels	417
6.1	Introduction	417
6.2	Outage Probabilities.....	418
6.2.1	Rayleigh Channels	418
6.2.2	Nakagami Channels	426
6.2.3	Shadowed Fading Channels.....	427
6.3	Average Probability of Error	433

- 6.3.1 Probability Density Function (Rayleigh Channels) 434
- 6.3.2 Probability Density Function (Nakagami Channels) 436
- 6.3.3 Probability Density Function (Shadowed Fading Channels)..... 436
- 6.3.4 Error Rates (Rayleigh Channels) 441
- 6.3.5 Error Rates (Nakagami Channels) 442
- 6.3.6 Error Rates (Shadowed Fading Channels)..... 445
- 6.3.7 Error Rates Following Diversity 448
- 6.4 Summary 451
- References..... 451
- Index** 455