

Contents

PREFACE	ix
ACKNOWLEDGMENTS	xi
Chapter 1. Probability	
1.1 Probability in Brief	1
1.2 Conditional Probability and Statistical Independence	2
1.3 Probability Distribution Functions	3
1.4 Continuous Random Variables	4
1.5 Functions of Random Variables	8
1.6 Characteristic Functions	14
1.7 Averages	17
Exercises	22
References	26
Supplementary Bibliography	26
Chapter 2. Random Processes	
2.1 Introduction	27
2.2 Relation to Probability	28
2.3 Ensemble Correlation Functions	30
2.4 Time Averages	36
2.5 Time Correlation Functions	39
2.6 Power Spectral Density	39
2.7 Response of Linear Filters	44
Exercises	51
References	54
Supplementary Bibliography	54

Chapter 3. Narrowband Signals

3.1	Introduction	55
3.2	Deterministic Signal	56
3.3	Hilbert Transform	61
3.4	Signal Preenvelope	69
3.5	Narrowband Filters	70
3.6	Narrowband Processes	75
3.7	Fourier Series Representation	78
	Exercises	83
	References	85
	Supplementary Bibliography	85

Chapter 4. Gaussian Derived Processes

4.1	Gaussian Properties	87
4.2	Sum of a Sine Wave and a Gaussian Process	99
4.3	Distribution of the Envelope of a Narrowband Gaussian Process	101
4.4	Envelope of a Sine Wave Plus Narrowband Noise	103
4.5	Envelope Squared of Narrowband Process	108
4.6	Chi-Squared Distribution	109
4.7	Envelope Squared of a Sine Wave Plus a Narrowband Process	112
4.8	Noncentral Chi-Squared Distribution	113
	Exercises	118
	References	122
	Supplementary Bibliography	123

Chapter 5. Hypothesis Testing

5.1	Introduction	125
5.2	Hypothesis Testing	126
5.3	Bayes Criterion	130
5.4	Minimum Error Probability Criterion	132
5.5	Neyman–Pearson Criterion	132
5.6	Minimax Criterion	135
5.7	Multiple Measurements	138
5.8	Multiple Alternative Hypothesis Testing	140
5.9	Composite Hypothesis Testing	143
5.10	Unknown A Priori Information	146
	Exercises	150
	References	154
	Supplementary Bibliography	154

Chapter 6. Detection of Known Signals

6.1	Introduction	155
6.2	A Binary Communication System	156
6.3	The Likelihood Functions	166
6.4	Matched Filters	167
6.5	An M -ary Communication System	179
6.6	Sampled Approach	183
	Exercises	189
	References	193
	Supplementary Bibliography	194

Chapter 7. Detection of Signals with Random Parameters

7.1	Introduction	196
7.2	Signals with Random Phase	196
7.3	The Quadrature Receiver and Equivalent Forms	200
7.4	Receiver Operating Characteristics	202
7.5	Signals with Random Phase and Amplitude	205
7.6	Noncoherent Frequency Shift Keying	209
7.7	Signals with Random Frequency	216
7.8	Signals with Random Time of Arrival	222
7.9	Random Frequency and Time of Arrival	224
7.10	Sampled Approach	225
	Exercises	227
	References	235
	Supplementary Bibliography	236

Chapter 8. Multiple Pulse Detection of Signals

8.1	Introduction	238
8.2	Known Signals	239
8.3	Signals with Random Parameters	241
8.4	Diversity	271
	Exercises	276
	References	281
	Supplementary Bibliography	282

Chapter 9. Detection of Signals in Colored Gaussian Noise

9.1	Introduction	285
9.2	Karhunen–Loeve Expansion	285
9.3	Detection of Known Signals	290
9.4	Receiver Performance	295
9.5	Optimum Signal Waveform	297
9.6	The Likelihood Functions	299
9.7	Integral Equations	300
9.8	Detection of Signals with Unknown Phase	310
	Exercises	318
	References	319
	Supplementary Bibliography	316

Chapter 10. Estimation of Signal Parameters

10.1	Introduction	321
10.2	Bayes Estimate	322
10.3	Maximum A Posteriori Estimate	324
10.4	Maximum-Likelihood Estimates	324
10.5	Properties of Estimators	325
10.6	Estimation in Presence of White Noise	331
10.7	Estimation of Specific Parameters	334
10.8	Estimation in Nonwhite Gaussian Noise	348
10.9	Generalized Likelihood Ratio Detection	352
	Exercises	357
	References	360
	Supplementary Bibliography	361

Chapter 11. Extensions Using Matrix Formulation

11.1	Introduction	363
11.2	Matrix Preliminaries	364
11.3	Multivariate Complex Gaussian Distribution	370
11.4	Estimation	371
11.5	Best Linear Estimator	372
11.6	Maximum Likelihood Estimation	374
11.7	Maximum A Posteriori Estimation	376
11.8	Detection	378
11.9	Gaussian Signal in Gaussian Noise	380
11.10	Space–Time Processing	383
	Exercises	395
	References	401
	Supplementary Bibliography	402
	INDEX	405

