

DETAILED TABLE OF CONTENTS (Volume II)

CHAPTER 9	ANALYSIS AND EXPERIMENTS IN STATISTICAL WAVE-PERIOD PROCESSING	1
9.1	Digital Measure of Modulo Wave-Period	1
9.2	Wave-Period Statistics for Various Inputs	9
9.3	Mean Wave-Period Shift (Doppler) Solution for a CW-Pulse Code	15
9.4	Wave-Period Scatter Solutions for a CW-Pulse Code	19
9.5	Wave-Period Solution for an FM-Slide Code	29
9.6	Wave-Period Solution for an FSK Code	34
9.7	Sea Test Experiments of Wave-Period Processing	35
	9.7.1 <i>Background Characteristics</i>	35
	9.7.2 <i>Detection Characteristics</i>	41
9.8	Implementation Aspects of the Wave-Period Distribution Processor	44
9.9	Background Signal for Homogeneous Randomly Distributed Reflectors (Reverberation Smearing)	48
9.10	Generalized Solution Output Peak Signal-to-Background Ratio	57
	9.10.1 <i>The Statistical Wave-Period Distribution Processor for an FM-Slide Transmission Code</i>	59
	9.10.2 <i>The Phase-Coherence Cross-Correlator</i>	62
	9.10.3 <i>Comparison of the Phase-Coherence and the Frequency-Coherence Processors in a Pure Reverberation Background</i>	67
9.11	Information Bandpass for Combined Reverberation and Noise	71

CHAPTER 10	A MODEL DETECTION PROCESSOR AND ITS OPERATIONAL CHARACTERISTICS	73
10.1	The Binomial Distribution Functions	75
	10.1.1 <i>Definitions</i>	75
	10.1.2 <i>Fundamental Relations</i>	77
10.2	The Simple Model Binomial Processor	79
10.3	The Model Absolute Value Processor Solution	82
10.4	The Model Simple “or” Processor Solution	88
10.5	The Model Absolute Value “or” Processor Solution	93
10.6	The Normalized Model Processor Equations	101
	10.6.1 <i>Probability that the Model Processor Outputs are Equal to or Greater Than x</i>	101
	10.6.2 <i>Normalized Mean Value of the Model Processor Outputs</i>	104
	10.6.3 <i>Normalized Second Moment of the Model Processor Outputs</i>	107
	10.6.4 <i>Normalized Variance of the Model Processor Outputs</i>	109
10.7	The ROC Equations for Higher Ordered “or” Processors	110
10.8	Approximation of the ROC Equations for Large m	111
10.9	Computation of the ROC Curves for the Model Processors	115
CHAPTER 11	FALSE TARGET RATE AND PER CENT OF CLUTTER IN DETECTION PROCESSORS	121
11.1	Relation of False Target Rate to Event False Target Probability	121
11.2	False Target Rate for Gaussian Noise—General Case	126
11.3	Envelope False Target Rate for Gaussian Noise	132
11.4	False Target Rate for Random Binomial Distributed Discrete Functions	138
11.5	Determination of $N(o)$ for Gaussian Noise	143
11.6	Determination of K_0 for Gaussian Noise	147
11.7	A Reassessment of the Definition of False Target Rate	149

11.8	On the Use of the False Target Rate Relations	155
11.8.1	<i>Discrete Binomially Distributed Systems</i>	155
11.8.2	<i>Analog Systems With Gaussian Distribution</i>	159
11.8.3	<i>Analog Systems With Amplitude Discard</i>	160
11.9	Number of False Targets Over a Given Display Field	161
CHAPTER 12	DESIGN PROCEDURES FOR WAVE-PERIOD DETECTION PROCESSORS	163
12.1	Determination of the Processor Parameters m and $p(r)$	165
12.2	Procedures for Determining the Mean Peak Output to <i>RMS</i> Background Ratio of the Detection Processor as a Function of the Input Signal-to-Background Ratio	168
12.3	Procedures for Determining the ROC Performance Curves	169
12.4	Examples of the Operational Performance Computed for Several Detection Processors	172
12.4.1	<i>Example No. 1</i>	173
12.4.2	<i>Example No. 2</i>	182
12.4.3	<i>Example No. 3</i>	186
12.4.4	<i>Example No. 4</i>	198
12.4.5	<i>Example No. 5</i>	206
12.4.6	<i>Example No. 6</i>	214
CHAPTER 13	AUTOMATIC TARGET LEVEL COMPENSA- TION FOR WAVE-PERIOD PROCESSORS	227
13.1	Noise Contamination Principle of Adaptive Output Level Control	228
13.2	Relation of Compensated Input Signal-to-Noise Ratio to the Amount of Noise Inserted	230
13.3	Design of the Target Level Compensation Processor	233
13.3.1	<i>TLC Processor Background Considerations</i>	234
13.3.2	<i>Compensated Detection Processor Output Level as a Function of the Input Signal-to- Background Ratio</i>	238
13.4	Example of the Design of a Target Level Compensated Frequency Coherence Processor	244

CHAPTER 14	EFFECTS OF SIGNATURE SMEARING IN PRACTICAL DETECTION PROCESSORS	257
14.1	The Nature and Causes of Signature Smearing	258
14.2	Time Scale-Factor (Doppler) Smearing	261
14.2.1	<i>The FM-Slide Transmission Code</i>	262
14.2.2	<i>Doppler Degradation in the Phase-Coherence Processor</i>	263
14.2.3	<i>Doppler Degradation in the Frequency-Coherence Processor</i>	264
14.2.4	<i>Examples of Doppler Smearing Degradation in Practical Applications</i>	269
14.3	Time-Register (Multipath) Smearing	276
14.3.1	<i>Nature of Multipath Phenomenon in Underwater Propagation</i>	277
14.3.2	<i>Effect of Multipath Smearing on the Received Signal</i>	282
14.3.3	<i>The Effect of Multipath Smearing on the Performance of the Phase-Coherence Type of Processor</i>	289
14.3.4	<i>The Effect of Multipath Smearing on the Performance of the Frequency-Coherence Type of Processor</i>	299
14.4	The Selection of the Transmission Signature Code and the Detection Processor for a Given Application	307
CHAPTER 15	FINE-GRAIN STATISTICAL WAVE-PERIOD PROCESSING	313
15.1	Fine-Grain Processing for Target Localization Utilizing the Mean Difference in Signal Axis-Crossovers Between Two Sensors	314
15.1.1	<i>Measurement of the Time Delay Variable τ</i>	318
15.1.2	<i>Data Display and Read-out Considerations</i>	320
15.1.3	<i>Standard Deviation of Fine-Bearing Measure as a Function of the Input Signal-to-Background Ratio</i>	323
15.1.4	<i>Examples of the Accuracy Achievable in Fine-Grain Bearing Measure</i>	327

15.2	Target Range-Rate Measure Utilizing the Mean Difference in Signal Axis-Crossovers Between the Target Return Signal and a Fixed Reference Signal .	334
15.2.1	<i>Technique for Range-Rate Measure Based on Axis-Crossover Intervals</i>	335
15.2.2	<i>Data Display and Read-out Considerations</i>	337
15.2.3	<i>Standard Deviation of Range-Rate Measure as a Function of the Input Signal-to-Background Ratio</i>	341
15.2.4	<i>Example of Accuracy Achievable in Range-Rate Measure</i>	346
15.3	Fine-Grain Processing for Target Localization Utilizing Pre-Processed Signals from the Phase-Coherence Cross-Correlator	351
15.4	Target Range-Rate Measure Utilizing the Phase-Coherence Processor and a Special FM-Slide Transmission Signature	360
15.4.1	<i>Basic Principle of Range-Rate Measure Using a Split Phase-Coherence Processor</i>	360
15.4.2	<i>Determination of Range-Rate from Delay Time τ_d</i>	365
15.4.3	<i>Examples of the Range-Rate Measuring System for Sonar Applications</i>	371
CHAPTER 16	INFORMATION STORAGE AND DISPLAY CONCEPTS FOR AN ACTIVE DETECTION SYSTEM	375
16.1	A Rapid-Scan Core Memory and Display Concept	375
16.2	Display and Control Console Concept	382
	INDEX	389