

CONTENTS

EDITOR'S FOREWORD	v
PREFACE	vii

INTRODUCTION	1
---------------------	----------

Chapter 1

NONLINEAR TRANSFORMATIONS WITHOUT FEEDBACK

1.1 Nonlinear Lagless Transformations	16
1.2 Nonlinear Transformations with Lag	43
1.3 The Problem of Synthesis. Optimal Conditions for Various Classes of Transformations	56
1.4 The Application of Methods of Synthesis. Nonlinear Filters	68
1.5 Statistical Linearization	77

Chapter 2

NONLINEAR TRANSFORMATIONS WITH FEEDBACK. STATIONARY STATES

2.1 A Short Description of the Basic Methods of Investigation	88
2.2 The Application of Statistical Linearization to the Analysis of Nonlinear Transformations with Normally Distributed Stationary Signals	91
2.3 Computation of Frequency Distortions Introduced by Nonlinear Elements	107
2.4 Restrictions Imposed by the Requirement That the Input Signal of the Nonlinear System Be Normal	115
2.5 The Synthesis of Linear Compensation Networks in Closed-Loop Systems with Nonlinearities	123
2.6 Application of the Theory of Markov Processes in the Study of Some Nonlinear Systems	138

Chapter 3**NONLINEAR TRANSFORMATIONS WITH
FEEDBACK. NONSTATIONARY STATES**

3.1	The Transformation of a Slowly Changing Signal in the Presence of a High-Frequency Random Interference	146
3.2	Passage of a Slowly Varying Random Signal through a System in a State with Periodic Oscillations	158
3.3	Transformation of the Sum of Wide-Band, Normal, Random Signals, and Harmonic Signals in a Nonlinear System with Feedback (Method of Statistical Linearization)	167
3.4	Random Disturbances of Periodic States in Relay Systems (Exact Solution by the Method of Alignment)	185

Chapter 4**EXTREMAL SYSTEMS**

4.1	Basic Principles of the Operation of Extremal Systems	211
4.2	Extremal Systems with a Time Separation between Testing and Operation; Systems with Proportional Action	222
4.3	Discrete Extremal Systems with Constant Steps	248
4.4	Extremal Systems in Which Testing and Operation Are Separated by a Frequency Band	269
4.5	An Automatic Extremal System with Simultaneous Testing and Operation	277

Appendix I**FUNCTIONS $m_y(m_x, \sigma_x)$, $h_1(m_x, \sigma_x)$, $a_2(m_x, \sigma_x)$, AND $a_3(m_x, \sigma_x)$ FOR SEVERAL TYPICAL NONLINEARITIES**

1.	The Ideal Relay $Y = l \operatorname{sgn} X$	293
2.	A Relay with a Dead Zone	294
3.	An Element with a Bounded Zone of Linearity	297
4.	An Element with a Dead Zone	297
5.	An Element with a Bounded Zone of Linearity and a Dead Zone	298
6.	An Element with a Characteristic of the Form $Y = Nx^2 \operatorname{sgn} x$	300
7.	An Element with the Characteristic $Y = Nx^3$	300
8.	A Relay with a Hysteresis Loop	301
9.	An Element with a Bounded Zone of Linearity with Nonsymmetrical Bounds	303

Appendix II

REPRESENTATION OF A LAGLESS NONLINEAR TRANSFORMATION IN THE FORM OF AN INTEGRAL TRANSFORMATION IN A COMPLEX REGION. THE THEOREM OF R. PRICE 304

Appendix III

COMPUTATION OF THE INTEGRALS I_n 309

Appendix IV

THE COEFFICIENTS OF STATISTICAL LINEARIZATION $h_1(a, \sigma)$ AND $h_2(a, \sigma)$ FOR TYPICAL NONLINEARITIES

1. The Ideal Relay	311
2. A Relay with a Dead Zone	313
3. An Element with a Bounded Zone of Linearity	314
4. An Element with a Bounded Zone of Linearity and Dead Zone	315
5. An Element with the Characteristic $f(X) = NX^2 \operatorname{sgn} x$	317
6. Elements with the Characteristic $f(X) = NX^{2n+1}$ where $n = 1, 2, 3, \dots$	317

Appendix V

ELEMENTARY STATEMENTS ON THE THEORY OF MARKOV PROCESSES

RELATED LITERATURE	329
BIBLIOGRAPHY	332
AUTHOR INDEX	339
SUBJECT INDEX	341