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Autore	Marmarelis Vasilis Z.
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Nota di contenuto	Prologue -- 1 Introduction -- 1.1 Purpose of this Book -- 1.2 Advocated Approach -- 1.3 The Problem of System Modeling in Physiology -- 1.4 Types of Nonlinear Models of Physiological Systems -- 2 Nonparametric Modeling -- 2.1 Volterra Models -- 2.2 Wiener Models -- 2.3 Efficient Volterra Kernel Estimation -- 2.4 Analysis of Estimation Errors -- 3 Parametric Modeling -- 3.1 Basic Parametric Model Forms and Estimation Procedures -- 3.2 Volterra Kernels of Nonlinear Differential Equations -- 3.3 Discrete-Time Volterra Kernels

of NARMAX Models -- 3.4 From Volterra Kernel Measurements to Parametric Models -- 3.5 Equivalence Between Continuous and Discrete Parametric Models -- 4 Modular and Connectionist Modeling -- 4.1 Modular Form of Nonparametric Models -- 4.2 Connectionist Models -- 4.3 The Laguerre-Volterra Network -- 4.4 The VWM Model -- 5 A Practitioner's Guide -- 5.1 Practical Considerations and Experimental Requirements -- 5.2 Preliminary Tests and Data Preparation -- 5.3 Model Specification and Estimation -- 5.4 Model Validation and Interpretation -- 5.5 Outline of Step-by-Step Procedure -- 6 Selected Applications -- 6.1 Neurosensory Systems -- 6.2 Cardiovascular System -- 6.3 Renal System -- 6.4 Metabolic-Endocrine System -- 7 Modeling of Multiinput/Multioutput Systems -- 7.1 The Two-Input Case -- 7.2 Applications of Two-Input Modeling to Physiological Systems -- 7.3 The Multiinput Case -- 7.4 Spatiotemporal and Spectrotemporal Modeling -- 8 Modeling of Neuronal Systems -- 8.1 A General Model of Membrane and Synaptic Dynamics -- 8.2 Functional Integration in the Single Neuron -- 8.3 Neuronal Systems with Point-Process Inputs -- 8.4 Modeling of Neuronal Ensembles -- 9 Modeling of Nonstationary Systems -- 9.1 Quasistationary and Recursive Tracking Methods -- 9.2 Kernel Expansion Method -- 9.3 Network-Based Methods -- 9.4 Applications to Nonstationary Physiological Systems -- 10 Modeling of Closed-Loop Systems -- 10.1 Autoregressive Form of Closed-Loop Model -- 10.2 Network Model Form of Closed-Loop Systems.

Appendix I: Function Expansions -- Appendix II: Gaussian White Noise -- Appendix III: Construction of the Wiener Series -- Appendix IV: Stationarity, Ergodicity, and Autocorrelation Functions of Random Processes -- References -- Index.

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## Sommario/riassunto

A practical approach to obtaining nonlinear dynamic models from stimulus-response data. Nonlinear modeling of physiological systems from stimulus-response data is a long-standing problem that has substantial implications for many scientific fields and associated technologies. These disciplines include biomedical engineering, signal processing, neural networks, medical imaging, and robotics and automation. Addressing the needs of a broad spectrum of scientific and engineering researchers, this book presents practicable, yet mathematically rigorous methodologies for constructing dynamic models of physiological systems. *Nonlinear Dynamic Modeling of Physiological Systems* provides the most comprehensive treatment of the subject to date. Starting with the mathematical background upon which these methodologies are built, the book presents the methodologies that have been developed and used over the past thirty years. The text discusses implementation and computational issues and gives illustrative examples using both synthetic and experimental data. The author discusses the various modeling approaches—nonparametric, including the Volterra and Wiener models; parametric; modular; and connectionist—and clearly identifies their comparative advantages and disadvantages along with the key criteria that must guide successful practical application. Selected applications covered include neural and sensory systems, cardiovascular and renal systems, and endocrine and metabolic systems. This lucid and comprehensive text is a valuable reference and guide for the community of scientists and engineers who wish to develop and apply the skills of nonlinear modeling to physiological systems.

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