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Autore	Shelhamer Mark
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Nota di contenuto	Preface; Contents; 1. The mathematical analysis of physiological systems: goals and approaches; 1.1 The goals of mathematical analysis in physiology; 1.2 Outline of dynamic systems; 1.3 Types of dynamic systems - random, deterministic, linear, nonlinear; 1.4 Types of dynamic behaviors - random, fixed point, periodic, quasi-periodic, chaotic; 1.5 Follow the ""noise""; 1.6 Chaos and physiology; General Bibliography; References for Chapter 1; 2. Fundamental signal processing and analysis concepts and measures; 2.1 Sampled data and continuous distributions; 2.2 Basic statistics 2.3 Correlation coefficient2.4 Linear regression, least-squares, squared-error; 2.5 Random processes, white noise, correlated noise; 2.6 Autocorrelation; 2.7 Concluding remarks; References for Chapter 2; 3. Analysis approaches based on linear systems; 3.1 Definition and properties of linear systems; 3.2 Autocorrelation, cross-correlation, stationarity; 3.3 Fourier transforms and spectral analysis; 3.4 Examples of autocorrelations and frequency spectra; 3.5 Transfer functions of linear systems, Gaussian statistics; References for Chapter 3; 4. State-

space reconstruction

4.1 State variables, state space4.2 Time-delay reconstruction; 4.3 A digression on topology; 4.4 How to do the reconstruction correctly; 4.5 Example: detection of fast-phase eye movements; 4.6 Historical notes, examples from the literature; 4.7 Points for further consideration; References for Chapter 4; 5. Dimensions; 5.1 Euclidean dimension and topological dimension; 5.2 Dimension as a scaling process - coastline length, Mandelbrot, fractals, Cantor, Koch; 5.3 Box-counting dimension and correlation dimension; 5.4 Correlation dimension - how to measure it correctly

5.5 Error bars on dimension estimates5.6 Interpretation of the dimension; 5.7 Tracking dimension overtime; 5.8 Examples; 5.9 Points for further consideration; References for Chapter 5; 6. Surrogate data; 6.1 The need for surrogates; 6.2 Statistical hypothesis testing; 6.3 Statistical randomization and its implementation; 6.4 Random surrogates; 6.5 Phase-randomization surrogate; 6.6 AAFT surrogate; 6.7 Pseudo-periodic surrogate; 6.8 First differences and surrogates; 6.9 Multivariate surrogates; 6.10 Surrogates tailored to specific physiological hypotheses; 6.11 Examples of different surrogates

6.12 Physiological examplesReferences for Chapter 6; 7. Nonlinear forecasting; 7.1 Predictability of prototypical systems; 7.2 Methodology; 7.3 Variations; 7.4 Surrogates, global linear forecasting; 7.5 Time-reversal and amplitude-reversal for detection of nonlinearity; 7.6 Chaos versus colored noise; 7.7 Forecasting of neural spike trains and other discrete events; 7.8 Examples; References for Chapter 7; 8. Recurrence analysis; 8.1 Concept and methodology; 8.2 Recurrence plots of simple systems; 8.3 Recurrence quantification analysis (RQA); 8.4 Extensions; 8.5 Examples

References for Chapter 8

Sommario/riassunto

This book provides a compilation of mathematical-computational tools that are used to analyze experimental data. The techniques presented are those that have been most widely and successfully applied to the analysis of physiological systems, and address issues such as randomness, determinism, dimension, and nonlinearity. In addition to bringing together the most useful methods, sufficient mathematical background is provided to enable non-specialists to understand and apply the computational techniques. Thus, the material will be useful to life-science investigators on several levels, from phys