Paperback Re-issue

The growing impact of nonlinear science on biology and medicine is fundamentally changing our view of living organisms and disease processes. This book introduces the application to biomedicine of a broad range of interdisciplinary concepts from nonlinear dynamics, such as self-organization, complexity, coherence, stochastic resonance, fractals, and chaos.

The book comprises 18 chapters written by leading figures in the field. It covers experimental and theoretical research, as well as the technological possibilities such as nonlinear control techniques for treating pathological biodynamics, including heart arrhythmias and epilepsy. The chapters review self-organized dynamics at all major levels of biological organization, ranging from studies on enzyme dynamics to psychophysical experiments with humans. Emphasis is on questions such as how living systems function as a whole, how they transduce and process dynamical information, and how they respond to external perturbations. The investigated stimuli cover a variety of different influences, including chemical perturbations, mechanical vibrations, thermal fluctuations, light exposures and electromagnetic signals. The interaction targets include enzymes and membrane ion channels, biochemical and genetic regulatory networks, cellular oscillators and signaling systems, and coherent or chaotic heart and brain dynamics. A major theme of the book is that any integrative model of the emergent complexity observed in dynamical biology is likely to be beyond standard reductionist approaches. It also outlines research needs and opportunities ranging from theoretical biophysics to cell and molecular biology, and biomedical engineering.

Front cover:
Self-organization of spiral wave patterns in nonliving (top row) and living (bottom row) systems. (Top, right) Population of spirals in catalytic carbon monoxide oxidation on a platinum surface. (Top, left) Spiral waves in the Belousov-Zhabotinsky reaction system.

(Bottom, left) Calcium spiral wave pattern in *Xenopus laevis* oocyte.

(Bottom, right) Self-organized aggregation of social amebae in the cellular slime mold *Dictyostelium discoideum*. The mathematical description of the underlying local processes in each system gives rise to partial differential equations that have the same nonlinear structure, thus explaining the intriguing similarities between otherwise greatly differing systems (for details see Steinbock and Müller, Chapter 17, this volume).

CAMBRIDGE
UNIVERSITY PRESS
ISBN 0-521-02607-5
9 780521 026079

Cover Design by Struktur