



## **Mathematics and Biosciences in Interaction**

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*Mathematics and Biosciences in Interaction* is devoted to the publication of advanced textbooks, monographs, and multi-authored volumes on mathematical concepts in the biological sciences. It concentrates on truly interdisciplinary research presenting currently important biological fields and relevant methods of mathematical modelling and analysis. Emphasis will be put on mathematical concepts and methods being developed and refined in close relation to problems and results relevant for experimental bioscientists.

The series aims at publishing not only monographs by individual authors presenting their own results, but welcomes, in particular, volumes arising from collaborations, joint research programs or workshops. These can feature concepts and open problems as a result of such collaborative work, possibly illustrated with computer software providing statistical analyses, simulations or visualizations.

The envisaged readership includes researchers and advanced students in applied mathematics – numerical analysis as well as statistics, genetics, cell biology, neurobiology, bioinformatics, biophysics, bio(medical) engineering, biotechnology, evolution and behavioral sciences, theoretical biology, systems theory.

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**FRACTALS** in  
**BIOLOGY** and  
**MEDICINE**

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Volume II

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# Contents

<b>Foreword</b> .....	ix
<b>Fractal Design of Biological Structures and Functions</b> .....	1
Some Remarks on Fractals and Dynamical Systems (Classical/Stochastic) in Biology <i>Sergio Albeverio</i> .....	2
Dynamical Generators of Lévy Statistics in Biology <i>B.J. West, P. Allegrini and P. Grigolini</i> .....	17
Biological Cellular Morphometry-Fractal Dimensions, Lacunarity and Multifractals <i>T.G. Smith, Jr. and G.D. Lange</i> .....	30
Spatial Pattern Analysis using Chaos Theory: A Nonlinear Deterministic Approach to the Histological Texture of Tumours <i>T. Mattfeldt</i> .....	50
Asymptotic Fractals <i>J.P. Rigaut, D. Schoëvaërt-Brossault, A.M. Downs and G. Landini</i> .....	73
Special Approaches of Image Analysis to the Measurement of Fractal Dimension <i>S. Eins</i> .....	86
Fractal Analysis of Landscapes in Medicine <i>G. Baumann, J. Dollinger, G.A. Losa and T.F. Nonnenmacher</i> .....	97
Fractal Regional Myocardial Blood Flows: The Anatomical Basis <i>J.B. Bassingthwaighe, D.A. Beard and R.B. King</i> .....	114
Arterial Vasomotion: Effect of Mechanical Forces and Evidence of Nonlinear Dynamics <i>C.-A. Porret, N. Stergiopoulos, S. de Brouwer, H. Achakri and J.-J. Meister</i> .....	128
Dynamical Analysis of Heartbeat Interval Time Series After Cardiac Transplantation <i>M. Meyer, C. Marconi, G. Ferretti, R. Fiocchi, F. Mamprin, J.E. Skinner and P. Cerretelli</i> .....	139
Low-Dimensional Chaos in Large Conductance Ca-Activated K-Channel Gating Kinetics <i>M. Meyer and J.E. Skinner</i> .....	152

<i>p</i> -Adic Model for Population Growth <i>A. Khrennikov</i> .....	165
Evolution of Life in a Fractal Universe <i>G. Damiani</i> .....	169
<b>Chromatin Structure, DNA Organisation and Nuclear Membranes</b> .....	189
Fractal Characterization of Nuclear Texture in Breast Cytology: Frequency and Spatial Domain Approaches <i>A.J. Einstein, H.-S. Wu and J. Gil</i> .....	190
Fractal Dimension of Perinuclear Membrane and of Nuclear Membrane-bound Heterochromatin in Human Breast Cancer Cells Targeted by Steroid Hormones <i>G.A. Losa, R. Graber, G. Baumann and T.F. Nonnenmacher</i> .....	207
Fractal Analysis of Heterochromatin Nuclear Domains in Lymphocytes <i>F. Marinelli, R. Santoro and N.M. Maraldi</i> .....	220
Fractal Approach to the Study of Chromatin Texture <i>F. Sepulcre, J. Grau, M. García-Bonafé and A. Moragas</i> .....	226
Fractal Dimension of Lymphocytic Nuclear Membrane in Mycosis Fungoides and Chronic Dermatitis <i>G. Bianciardi, C. Miracco, M. Margherita de Santi, A. Perrone, A. Bruni and P. Luzi</i> .....	231
Modeling the Dynamics of Nonenzymatic and Enzymatic Nucleotide Processes by Fractal Dimension <i>Z. Földes-Papp, B. Angerer, W. Ankenbauer, G. Baumann, E. Birch-Hirschfeld, S. Björling, S. Conrad, M. Hinz, R. Rigler, H. Seliger, P. Thyberg and A.K. Kleinschmidt</i> .....	238
A Headful of T4 Coliphage DNA Packaged to Fasces-Like Globules in Fractal Models <i>A.K. Kleinschmidt, G. Baumann, R. Martin and R.K. Zahn</i> .....	255
<b>Fractal Structures in Tumours and Diseases</b> .....	267
Complexity in Tumour Growth Patterns <i>G. Landini</i> .....	268
Fractal Dimension of Epithelial-Connective Tissue Interface in Basal Cell Carcinoma of the Skin <i>C. Miracco, G. Bianciardi, A. Perrone, A. Bruni, S. Lazzi and P. Luzi</i> .....	284

Fractal Geometry of the Human Renal Arterial Tree in Development, Health and Disease <i>S.S. Cross</i> .....	294
Discriminating Properties of Wide Dynamic Range Neurons by Means of Universal Multifractals <i>G. Salvadori and G. Biella</i> .....	314
Fractal Analysis of Nuclear Medicine Scans <i>E. Oczeretko, F. Rogowski and D. Jurgilewicz</i> .....	326
Changes in Bone Strength during Repair Predicted by Fractal Analysis of Radiographs <i>R.J.C. Wilding, M.M. Ferguson, N. Parr, G. Mckellar and B.K. Adams</i> .....	335
Fractal Distribution of Serosal Lymphatics <i>D. Venturoli, S. Grungo, D. Negrini and G. Miserocchi</i> .....	345
NMR Studies of Anomalous Diffusion in Biological Tissues: Experimental Observation of Lévy Stable Processes <i>M. Köpf, R. Metzler, O. Haferkamp and T.F. Nonnenmacher</i> .....	354
<b>Index</b> .....	365

# Foreword

This volume contains oral and poster presentations given at the Second International Symposium on *Fractals in Biology and Medicine* held in Centro Seminariale Monte Verità, Ascona, Switzerland, from March 6–9, 1996. Scientists from around the world came together again to present and discuss in an exciting atmosphere their research papers as well to exchange information on their more recent experimental findings and theoretical interpretations. Since the publication of Benoit Mandelbrot's book, *The Fractal Geometry of the Nature*, the fractal concept has been rapidly pushed forward essentially by mathematicians and physicists alike. Significant progress has been made over the last years in understanding of how to analyze natural shapes and structures, favoured also by the continuing improvements in computational capabilities. Hence, the time has come to embrace the fields of biology and medicine. Indeed, most of the participants have been focused some or all of their activities on biomedical research problems so that the potential of the fractal geometry and its practical use for describing and measuring irregular biological objects such as organs, tissues and cells as well as for understanding several complex pathogenetic processes could be explored with the adequate criticism. A special emphasis has been devoted to the complex field of human tumours, by addressing the role of fractals in the design, organization and measurement of cellular and molecular structures and the growth patterns in breast and skin carcinoma, in leukemic and lymphoma cells, in bone, lung, nervous and renal diseases.

In presenting the different contributions in this volume, we did not follow the chronological sequence of sessions. Rather, we arranged the proceedings as to grouping similar topics together.

We are particularly indebted to the following renowned institutions: International Society for Stereology, International Society for Diagnostic Quantitative Pathology, Swiss National Science Foundation, Swiss Academy of Sciences, Institute for Scientific and Interdisciplinary Studies, Research Center for Mathematics and Physics, who accepted to confer their scientific patronage and also to the sponsors, Dipartimento dell'Istruzione e Cultura del Canton Ticino, Maurice E. Müller Foundation, Swiss National Science Foundation, Becton Dickinson AG., and Beckman Instruments International SA., who made the achievement of this symposium possible.

Our thanks are also due to Dr. Mauro Martinoni, head of the Ufficio Studi Universitari del Canton Ticino for his precious support, to our collaborators Dr. Riccardo Graber and Christian Castelli and to Mr. Luca Albertini, managing director of the Centro Seminariale Monte Verità, who made the conference run «fractally».

Monte Verità, Ascona 1996

The Editors