

**Proceedings of the 12th Annual  
International Conference of the  
IEEE Engineering in  
Medicine & Biology Society**

**Vol. 4**

# **Proceedings of the Twelfth Annual International Conference of the IEEE Engineering in Medicine and Biology Society**

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EDITED BY

**Peder C. Pedersen  
Banu Onaral**

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## **Part 4/5**

*Bioelectric and Biophysical Aspects of Bioengineering, Molecular Electronics,  
and Models of Physiological Systems*

THIS PART CONTAINS:

- Track 1: Bioelectric Phenomena
- Track 14: EM Interactions
- Track 7: Biophysical and Biochemical Measurements
- Track 22: Molecular Electronics
- Track 25: Physiological Systems and Models

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## PREFACE



### Proceedings of the Twelfth Annual International Conference of the IEEE Engineering in Medicine and Biology Society

Philadelphia, Pennsylvania, USA • November 1 - 4, 1990

These Proceedings represent the archival record of the 12th Annual International Conference of the Institute of Electrical and Electronics Engineers — Engineering in Medicine and Biology Society. The purpose of the Conference is to provide an international forum for the exchange and the dissemination of the latest scientific and technical information in biomedical engineering, to cover important developments in engineering and science which may impact biomedical engineering, and to give the participants a sense of future directions in health care technologies and biomedical research.

The Conference has steadily grown to become the largest meeting of biomedical engineers in the world. Its major strength and importance lie in the ability to unify the broad and diverse fields of biomedical engineering. In 1990, the Conference derives its breadth and depth from the cumulative efforts of over 2500 biomedical engineers and scientists worldwide and the generous funding and assistance from several corporations and agencies acknowledged on the previous page. These contributions have resulted in approximately 1200 referred papers spanning 30 Program Tracks, four Mini-Symposia, and several Special Program Events.

Following the model of the previous conferences, the Proceedings are organized into five Parts each of which comprises papers from groups of related tracks. Two 'Overview' pages included in each Part of the Proceedings prior to the Table of Contents are intended to help the reader cross-reference Program Tracks, Mini-Symposia and Special Events with the corresponding Proceedings Parts and pages.

A conference of this magnitude is founded on the dedicated collaboration of a great number of volunteers. Our deep appreciation for the sincere commitment demonstrated by each and every member of the Conference Committee is acknowledged through the listings over the following two pages. We recognize with special gratitude the Chairs and Organizers of the Programs Tracks, the Special Program Events, the Mini-Symposia, the Technical Sessions and the Student Activities. The strong international participation in the Conference is a testament to the diligence of the International Committee under the leadership of Dr. Joachim H. Nagel. Our predecessors who had traveled the path before us, especially the Chairs of the 1989 Conference, Dr. Francis A. Spelman and Dr. Yongmin Kim, have been a source of advice and encouragement. We have also been privileged to enlist the solid support of many past and present officers of the Engineering in Medicine and Biology Society, in particular Dr. Barry Feinberg, Dr. Charles J. Robinson, Dr. Susan M. Blanchard and Dr. Willis J. Tompkins. Many members of the staff at our respective institutions have cheerfully assisted us with the daily chores.

Finally, we would like to thank Dr. Lawrence R. Whicker and Mrs. Margaret R. Whicker of LRW Associates for their skillful services in providing the professional management of the Conference, to Mr. Andrew Short of Bumper Crop Studios for his tireless efforts and artistic touch in producing the Advance and Final Programs, and the Proceedings under extreme time pressure, to Mr. Michael Sherman from University Relations, Worcester Polytechnic Institute, for his fine work on letterhead and graphical design and to Ms. Mary Schiminsky and Dr. Maryam Moussavi from Drexel University for their able assistance to exhibit organizers.

Dr. Peder C. Pedersen  
Program Chair

Dr. Banu Onaral  
Conference Chair





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BIOMEDICAL ENGINEERING PERSPECTIVES:  
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Michael Conrad, Department of Computer Science, Wayne State University, Detroit, MI	
<b>22.11-1: Non Definite Form for Autopoiesis, Illustrating Automata in the Forward and Backward Time</b>	<b>1778</b>
Y. Gunji, T. Nakamura, Department of Earth Sciences, Faculty of Science, Kobe University, Kobe, Japan	
<b>22.11-2: The Neurodynamics of Context Reverberation Learning</b>	<b>1781</b>
Kevin G. Kirby and Nancy Day, Department of Computer Science and Engineering, Wright State University, Dayton, OH	
<b>22.11-3: Syntax-Driven Neuromolecular Learning</b>	<b>1783</b>
Kiumi Akingbehin, Dept. of Electrical and Computer Engineering, University of Michigan, Dearborn, MI	
<b>22.11-4: Two-Level Dynamics of Molecular Computation</b>	<b>1785</b>
K. Matsuno, Nagaoka University of Technology, Nagaoka, Japan	
<b>22.11-5: High Tc Superconductor Optoelectronic Switch for High Density Sensing &amp; Neurocomputing</b>	<b>1786</b>
Harold H. Szu, Naval Research Laboratory, Washington, DC	
<b>22.12A-1: Spatial Light Modulators and Optical Associative Memories Based on Bacteriorhodopsin</b>	<b>1788</b>
Robert R. Birge, Paul A. Fleitz, Rick B. Gross, John C. Izgi, Albert F. Lawrence, Jeffrey A. Stuart, Jack R. Tallent, Center for Molecular Electronics, Syracuse Univ., Syracuse, NY	
<b>22.12A-2: Single-Electronics and Molecular Electronics</b>	<b>1790</b>
K.K. Likharev, Department of Physics, Moscow State University, Moscow, USSR	
<b>22.12A-3: Are the Molecular Electronics of the Reaction Centres of Bacteria and Photosystem Two Comparable?</b>	<b>1792</b>
J. Barber, Imperial College, London, UK	
<b>22.12B-1: Combined Molecular Electronic Devices Based on One-Dimensional Semiconductors and Molecular Components</b>	<b>1794</b>
Anvar Z. Zakhidov, Molecular Systems Laboratory, Department of Thermophysics, Uzbek Academy of Sciences, Tashkent, USSR	
<b>22.12B-2: Neural Networks for Control: An Overview</b>	<b>1796</b>
P. J. Werbos, National Science Foundation, Washington, DC	
<b>22.12B-3: Pyroelectricity of Molecular and Molecular-Ionic Materials</b>	<b>1798</b>
J. Sworakowski, Technical University of Wroclaw, Wroclaw, Poland	
<b>P.22-1: Ultrathin Organic Multilayer Films Via Salt Formation: Easy Access to Tailor-Made Coatings in the Thickness Range of 1nm - 500nm</b>	<b>1800</b>
G. Decher and J.-D. Hong, Institut für Physikalische Chemie, Johannes Gutenberg-Universität Mainz, Mainz, Federal Republic of Germany	
<b>P.22-2: Determination of the Orientation of Bacteriorhodopsin in Langmuir-Blodgett Multilayer Film by Linear Dichroism</b>	<b>1801</b>
M.-q. Tan, A.-j. Wang, K.-s. Hu, J.-r. Li* and L. Jiang*, Institute of Biophysics, Academia Sinica, Beijing, China, * Institute of Photographic Chemistry, Academia Sinica, Beijing, China	
<b>P.22-3: Optoelectronic Properties of Cu-TCNQ Thin Films - for Models of Associative Memory with MED</b>	<b>1803</b>
Ning Gu, Chun-Wei Yuan, Yu Wei, Laboratory of Molecular and Biomolecular Electronics, Southeast University, Nanjing, P.R. China	
<b>P.22-4: Electrical Transport in Polydiacetylenes: Models for "Molecular Wires"</b>	<b>1805</b>
J. Sworakowski, Poland	
<b>P.22-5: Single Models for Intermediate One-Electro States in 2- and 3-Dimensional Bounded Crystal Lattices</b>	<b>1807</b>
G. Biczó, Central Research Institute of Chem., Hungarian Academy of Sciences, Budapest, Hungary	

**Track 25: Physiological Systems and Models**

<b>25.1-1: Assessment of Parasympathetic Function from an Analysis of the Dynamics of Cardiac Period Response to Vagal Stimulation</b>	<b>1809</b>
B.G. Celler, N.H. Lovell, Systems Physiology Lab., Schl. of Elect. Eng., Univ. of NSW, Australia Centre for Biomed. Tech., Univ. of Tech., Sydney, Australia	
<b>25.1-2: Continuous Simulation Language Model of Intra-Aortic Balloon Pumping</b>	<b>1811</b>
J.D. Olson, V.C. Rideout, Dept. of Electrical and Computer Engineering, University of WI, Madison, WI	
<b>25.1-3: A New Mathematical Model for Right Ventricular Geometry</b>	<b>1813</b>
Ferenc Czegledy, *Nicole Aebischer, Ari Tamari, Anthony Torolani, Dept. of Surg., North Shore Hosp., Manhasset, NY, *Dept. of Medicine, Brown University, Providence, RI	
<b>25.1-4: An Analog Model for the Interaction Between Systemic and Coronary Circulation</b>	<b>1815</b>
Taisheng Zheng and Ying Sun*, Dept. of Automation & Computer Eng., Guang Zhou, China, *Dept. of Electrical Eng., Kingston, RI	
<b>25.1-5: Assessment of the True Pulse-Wave Velocity Over the Physiological Pressure Range</b>	<b>1817</b>
Y. Tardy, P. P. Veiyres*, J. J. Meister, Dept. of Physics, Swiss Inst. of Technology, Lausanne, Switzerland, *Medical Biophysics Laboratory, Tours University, France	
<b>25.2-1: A Noninvasive Measure of Alveolar Pressure</b>	<b>1819</b>
P. Gizdulich, P. Passalacqua, L. Viroli, P. Panuccio, Department of Clinical Physiopathology, Florence University, Florence, Italy	
<b>25.2-2: Recursive Least Squares Estimation of Transpulmonary Contrast Medium Transport by Ultrafast Computed Tomography</b>	<b>1821</b>
C.J. Wolfkiel, Dept. of Medicine, Section of Cardiology, Univ. of Illinois at Chicago, Chicago, IL	
<b>25.2-3: Load Dependence of Cardiac Parameters: A Model-Based Study</b>	<b>1823</b>
G. Avanzolini, A. Cappello, Dipartimento di Elettronica, Informatica e Sistemistica, University of Bologna, Bologna, Italy	
<b>25.2-4: Propagation of a Pulse Wave Along an Artery</b>	<b>1825</b>
E. Belardinelli, S. Cavalcanti, Department of Electronics, Computer Science and Systems, University of Bologna, Bologna, Italy	
<b>25.2-5: A Proposal of a Model for the Renal Nerve Activity Role on the Renal Blood Flow Regulation</b>	<b>1827</b>
L. Roa and F. Garrachon, Grupo de Ingenieria Biomedica, Escuela Superior de Ingenieros Industriales, Universidad de Sevilla, Spain	
<b>25.2-6: A Time Domain Model of Arterial Pressure Pulse Propagation</b>	<b>1829</b>
D.L. Lizotte, J.R. LaCourse, Elect. and Comp. Eng. Dept., Kingsbury Hall, Univ. of New Hampshire, Durham, NH	
<b>25.3-1: A Mathematical Model of the Effects of Sympathetic and Parasympathetic Stimulation on the Heart Rate</b>	<b>1831</b>
T.F. Itani, E. Koushanpour, M.H. Paul, Dept. of Biomed. Eng., Northwestern Univ., Evanston, IL, Dept. of Physiology, Northwestern Univ. Med. School, Chicago, IL, Div. of Cardiology, Children's Memorial Hospital, Chicago, IL	
<b>25.3-2: Dynamics of Viral Encephalitis Transmission by Mosquitoes</b>	<b>1833</b>
Joe Eisenberg, Robert C. Spear, Bioengineering Group and School of Public Health, University of California, Berkeley, Berkeley, CA	
<b>25.3-3: Modeling Eipb in Thoroughbreds</b>	<b>1835</b>
Arthur T. Johnson, Agricultural Engineering Department, University of Maryland, College Park, MD	
<b>25.3-4: A Hill-Type Model of the Urinary Bladder</b>	<b>1837</b>
M. Damaser, S. Lehman, and M. Stoller*, Joint UC Berkeley/UC San Francisco Program in Bioengineering, and *US San Francisco Dept. of Urology, San Francisco, CA	
<b>25.3-5: Effects of Barriers in Plane Wave Propagation in a Two Dimensional Model of Anisotropic Cardiac Tissue</b>	<b>1839</b>
N. Magiaveras, A.V. Sahakian*, F. VanCappelle**, M. Alessie***, C.Pappas, M. Strintzis, Aristolion Univ., Thessaloniki, Greece, *Northwestern Univ., Evanston, IL, **Univ. of Amsterdam, Amsterdam, Holland	
<b>25.3-6: Autoregressive Modelling of Post-Operative Epileptic MEG Measurements</b>	<b>1841</b>
A. Angelidou, M.G. Strintzis, S. Panas and G. Anogianakis, Depts. of Electr., & Comp. Eng., of Telecom, and of Exper. Physiology, University of Thessaloniki, Greece	
<b>25.4-1: Self-Organization of Pathological Systems Induced by Electric Currents</b>	<b>1843</b>
Aneta Stefanovska and Lojze Vodovnik, Department of Biocybernetics, Faculty of Electrical and Computer Engineering, University of Ljubljana, Ljubljana, Yugoslavia	

<b>25.4-2: Utilization of Linear Prediction and Nonlinear Filtering for the Enhancement of Canine Gastric Signals</b>	<b>1846</b>
M. Tanyel, V. K. P. Rao Chitrapu, W. Y. Chey*, and K. Y. Lee*, Elect. & Comp. Engr., Drexel University, Philadelphia, PA, * The Genesee Hospital, Rochester, NY	
<b>25.4-3: Computer Simulation of the Respiratory Control System in the Newborn Infant</b>	<b>1848</b>
Fleur T. Tehrani Dept. of Electrical Eng., CA State Univ., Fullerton, CA	
<b>25.4-4: Assessment of Sympathetic Function By Simultaneously Recording of Skin Vasomotor Reflex and Impedance Electrodermal Response</b>	<b>1851</b>
C. Ionescu-Tirgoviste, S. Prune, D. Petre, and L. Pop, Electrophysiology and Biomedical Engineering Lab., Clinic of Diabetes, Nutrition and Metabolic Diseases, Bucharest, Romania	
<b>25.4-5: New Hypothesis in Breast Cancer Growth Mechanism</b>	<b>1853</b>
Abou Bakr M. Youssef, Ahmed S. Mohamed, Cairo University, Giza, Egypt	
<b>25.4-6: Alternative Circuit Model for the Hodgkin-Huxley Nerve Axon</b>	<b>1855</b>
Roy Barboza, Departamento de Electricidade, Escola de Engenharia de Sao Carlos, Universidade de Sao Paulo, Sao Carlos, SP, Brazil	
<b>25.5-1: Qualitative, Noninvasive Method of Detecting Nonuniform Ventilation-Perfusion Distribution</b>	<b>1857</b>
Yasemin Palanduz Kuhya, Bogazici University, Department of Electrical-Electronic Engineering, Istanbul, Turkey	
<b>25.5-2: Identification of Central Respiratory Chemical Controller in Man Using Prediction-Error Method</b>	<b>1859</b>
Mohammad Modarreszadeh and Eugene N. Bruce, Dept. of Biomedical Engineering, Case Western Reserve University, Cleveland, OH	
<b>25.5-3: The Topologic Structure of a Model of Periodic Ventilation</b>	<b>1861</b>
A. Gottschalk*, M.C.K. Khoo**, and A.I. Pack*, *Hospital of the University of Pennsylvania, ** University of Southern California, CA	
<b>25.5-4 The Applicability of Methods from Nonlinear Dynamics in Assessing Physiological States of the Respiratory System</b>	<b>1863</b>
Charles L. Webber, Jr., Joseph P. Zbilut, Departments of Physiology, Loyola University of Chicago, Maywood, IL and Rush Medical College, Chicago, IL	
<b>25.5-5: The Ventilatory Consequences of Noise in Respiratory Chemical Feedback Loops</b>	<b>1865</b>
Eugene N. Bruce and Mohammad Modarreszadeh, Dept. of Biomedical Engineering, Case Western Reserve University, Cleveland, OH	
<b>25.5-6 Maximizing Data Collection from the Isolated Perfused Working Lung Model</b>	<b>1867</b>
J. Locicero III, M. Massad, J. deTarnowsky, Northwestern Univ. Medical School, Chicago, IL	
<b>25.6-1: Analysis of the Interaction Between the Sympathetic and Chemical Mechanisms in Cerebral Blood Flow Regulation</b>	<b>1870</b>
M. Ursino and P. Di Giammarco, Department of Electronics, Computer Science and Systems, Bologna, Italy	
<b>25.6-2: Mathematical Analysis of the Baroreflex Regulation and Its Interaction with Blood Flow Regulation</b>	<b>1872</b>
P. Di Giammarco, E. Belardinelli, and M. Ursino, Department of Electronics, Computer Science and Systems, Bologna, Italy	
<b>25.6-3: The Relation Between Respiratory Related Waves in Arterial Blood Pressure and Heart Rate</b>	<b>1874</b>
Th.J.C. Faes*, P. Lanting**, R. Kingma**, B.J. TenVoorde*, and O. Rompelman**, *Dept. of Medical Physics, **Dept. of Neurology, Free University, Amsterdam, The Netherlands	
<b>25.6-4: A Model of Blood Volume Change During Dialysis</b>	<b>1876</b>
Jerome C. James III, Department of Veterans Affairs Medical Center, and Department of Biomedical Engineering, University of Alabama at Birmingham, Birmingham, AL	
<b>25.6-5: Identification of Patient-Sensitivity, Baseline-Pressure, and Infusion-Delay Using Fast Spectral Estimates During Closed-Loop Control of Mean Arterial Pressure</b>	<b>1878</b>
David T. Johnson*, Alan M. Schneider*, James F. Martin**, and Michael L. Quinn***, *Univ. of CA at San Diego, **IVAC Corp., San Diego, ***UCSD & USVA Med Ctrs, San Diego, CA	
<b>25.6-6: Transfer Function Analysis Applied to Acoustic Transmission from Airways to Chest Wall</b>	<b>1880</b>
G.R. Wodicka, School of Elect. Eng. & Hillenbrand Biomed. Eng. Cntr., Purdue Univ., West Lafayette, IN	
<b>25.7-1: Cortical Computation of Motion Energy: Location of the Squarer</b>	<b>1882</b>
Robert C. Emerson*, Michael J. Korenberg**, Mark C. Citron+, *Dept. of Ophthalmology, Univ. of Rochester, NY, **Dept. of EE, Queen's Univ., Canada, +Neurology Research, CA	