

科技资料

1990 IEEE  
Computers in Cardiology

**Proceedings**

# **Computers in Cardiology**

*Chicago, Illinois*  
**September 23-26, 1990**



**IEEE Computer Society Press**  
**Los Alamitos, California**

**Washington • Brussels • Tokyo**

The papers in this book comprise the proceedings of the meeting mentioned on the cover and title page. They reflect the authors' opinions and are published as presented and without change, in the interests of timely dissemination. Their inclusion in this publication does not necessarily constitute endorsement by the editors, the IEEE Computer Society Press, or The Institute of Electrical and Electronics Engineers, Inc.

Published by

1951-1991



IEEE Computer Society Press  
10662 Los Vaqueros Circle  
P.O. Box 3014  
Los Alamitos, CA 90720-1264

© 1991 by the Institute of Electrical and Electronics Engineers, Inc. All rights reserved.

**Copyright and Reprint Permissions:** Abstracting is permitted with credit to the source. Libraries are permitted to photocopy beyond the limits of U.S. copyright law for private use of patrons those articles in this volume that carry a code at the bottom of the first page, provided the per-copy fee indicated in the code is paid through the Copyright Clearance Center, 29 Congress Street, Salem, MA 01970. Instructors are permitted to photocopy isolated articles for noncommercial classroom use without fee. For other copying, reprint or republication permission, write to Director, Publishing Services, IEEE, 345 East 47th Street, New York, NY 10017.

**IEEE Computer Society Press Order Number 2225**

Library of Congress Number 80-641097  
IEEE Catalog Number 90CH3011-4  
ISBN 0-8186-2225-3 (paper)  
ISBN 0-8186-6225-5 (microfiche)  
ISBN 0-8186-9225-1 (case)  
ISSN 0276-6574

Additional copies can be ordered from:

**IEEE Computer Society Press**  
Customer Service Center  
10662 Los Vaqueros Circle  
P.O. Box 3014  
Los Alamitos, CA 90720-1264

**IEEE Computer Society**  
13, avenue de l'Aquilon  
B-1200 Brussels  
BELGIUM

**IEEE Computer Society**  
Ooshima Building  
2-19-1 Minami-Aoyama,  
Minato-Ku  
Tokyo 107, JAPAN

**IEEE Service Center**  
445 Hoes Lane  
P.O. Box 1331  
Piscataway, NJ 08855-1331

Production Editor: Wally Hutchins

Printed in the United States by McNaughton and Gunn, Inc.

 THE INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS, INC.

## **Sponsors**

Illinois Institute of Technology  
Pritzker Institute of Medical Engineering  
National Institutes of Health  
National Heart, Lung and Blood Institute  
Division of Computer Research and Technology  
American Heart Association of Metropolitan Chicago  
European Society of Cardiology  
Colin Research America  
Corazonix Corporation  
Intermedics, Inc.  
Eli Lilly and Company, Medical Instrument Systems Division  
Marquette Electronics, Inc.  
Medtronic, Inc.  
Quinton Instrument Company  
Spacelabs

## **Organizing Committee Members**

### **Chairman**

**Jurgen Meyer, M.D.**  
Medical Clinic II  
Johannes-Gutenberg University  
D-6500 Mainz, Germany

### **Chairman and Continuing Medical Education Officer**

**Roger G. Mark, M.D., Ph.D.**  
Harvard-MIT Division of Health Sciences and Technology  
Cambridge, Massachusetts 02139 USA

### **President**

**Cees Zeelenberg, M.S.**  
Thoraxcentrum  
Erasmus University  
Rotterdam, The Netherlands

### **Past President**

**Jerome R. Cox, Jr., D.Sc.**  
Department of Computer Science  
Washington University  
St. Louis, Missouri 63130 USA

### **Chairman of the Scientific Committee**

**William J. Sanders**  
Cardiology Division  
Stanford Medical Center  
Stanford, California 94305 USA

### **Treasurer**

**Harold G. Ostrow, M.S.**  
Division of Computer Research and Technology  
National Institutes of Health  
Bethesda, Maryland 20892 USA

### **Proceedings Editor**

**Allan Murray, Ph.D.**  
Regional Medical Physics Dept.  
Freeman Hospital  
Newcastle-Upon-Tyne, UK

**Kenneth L. Ripley, M.S.**  
Pritzker Inst. of Medical Eng.  
Illinois Inst. of Technology  
Chicago, Illinois 60616 USA

### **Scientific Society Liaison Officer**

**Carlo Marchesi, E.E. Dr.**  
Department of Systems & Informatics  
University of Florence and  
CNR Inst. of Clinical Physiology  
Pisa, Italy

## **Local Organizing Committee**

### **Chairman**

**Robert Arzbaecher, Ph.D.**

### **Vice Chairman**

**Kenneth L. Ripley, M.S.**

### **Members**

**Janine Larsen, Ph.D.**

**Hossein Jadvar, Ph.D.**

**Geoffrey Cottrell, Ph.D.**

### **Conference Administrator**

**Catherine D'Amico**

### **Conference Staff**

**Proceedings**

**Tim Ripley**

Pritzker Institute of Medical Engineering  
Illinois Institute of Technology  
Chicago, IL 60616  
USA

## **Introduction**

Computers in Cardiology holds its seventeenth consecutive annual scientific meeting this year in Chicago, on the shores of beautiful Lake Michigan in the heart of the United States. We look forward to an exciting and enriching program which will bring together cardiologists, physiologists, and engineers from the USA and Europe who share a common interest in the application of modern technology to clinical and research problems in cardiology.

Several aspects of this meeting hold special promise. Our hosts Bob Arzbaecher and Ken Ripley, with the support of the local committee, have organized a special symposium on Sunday in collaboration with the American Heart Association of Metropolitan Chicago. A panel of international experts in cardiology and biomedical engineering will review the latest technology available for the diagnosis and treatment of cardiac rhythm disturbances. We are grateful to the AHA and to a number of industrial sponsors whose support has made this special symposium possible. We also acknowledge the receipt of a grant from the National Institutes of Health which will partially underwrite the expenses of this year's meeting of Computers in Cardiology.

The social program planned by our local hosts will be a memorable one, and celebrates the beauty of Chicago as seen from the waterfront. We hope it will be a time for renewal of old friendships and the making of new ones.

We send our thanks and congratulations to the local hosts. We look forward to the outstanding technical program, and a time of social and scientific enrichment.

**Roger Mark, M.D., Ph.D.  
Jurgen Meyer, M.D.  
Cees Zeelenberg, M.S.**

# **1990 Computers in Cardiology**

## **Chicago, Illinois, U.S.A.**

### **Table of Contents**

<b>Plenary Session I</b>	
<b>Cardiac Imaging</b>	
Roger G. Mark and Jürgen Meyer	<b>1</b>
<b>3-D Visualisation for the Study of Arterial Disease and Tissue Characterisation</b>	<b>3</b>
R.I. Kitney, C. Burrell, K. Straughan, L. Moura, M.T. Rothman	
<b>An Automated Method for Simultaneous Detection of Left and Right Coronary Borders</b>	<b>7</b>
S.M. Collins, C. Wilbricht, S.R. Fleagle, S. Tadikonda, M.D. Winniford	
<b>Densitometric Determination of Absolute Cross-Section Areas of Coronary Arteries</b>	<b>9</b>
U. Solzbach, M. Rombach, R. Waltenspiel, H. Wollschläger, H. Just	
<b>Obtaining Blood Velocity Profile from Coronary Arteriograms via Optimally Controlled Optical Flow</b>	<b>13</b>
R. Mongrain, M. Bertrand, G.E. Mailloux, J. Meunier, M.G. Bourassa, R. Camarero	
<b>An Artificial Vision System for Coronary Angiography</b>	<b>17</b>
R. Poli, G. Coppini, M. Demi, G. Valli	
<b>Plenary Session II</b>	
<b>New Approaches to the Study of Cardiac Arrhythmias</b>	<b>21</b>
Rosanna Degani and Raymond Ideker	
<b>The Use of Computer Animation of Mapped Cardiac Potentials in Studying Electrical Conduction Properties of Arrhythmias</b>	<b>23</b>
C. Laxer, C.A. Alferness, W.M. Smith, R.E. Ideker	
<b>New Approaches to Study Late Potentials Using High Resolution ECGs and Cardiac Maps of the End of Activation</b>	<b>27</b>
E. Berbari, P. Lander, D. Geselowitz, B. Scherlag, R. Lazzara	
<b>Global Analysis of Self-sustained Reentry by Cellular Automata Models</b>	<b>31</b>
B.E.H. Saxberg, R.J. Cohen	
<b>Computer Analysis of Right Ventricular Pressure for Improved Discrimination of Ventricular Tachyarrhythmias</b>	<b>35</b>
H. Jadvar, T. Bump, R. Arzbaecher	

**Session 1**  
**Myocardial Imaging**  
Ernest Byrom

39

<b>Shape-Based Tracking of Left Ventricular Wall Motion</b>	41
J. Duncan, R. Owen, P. Anandan, L. Staib, T. McCauley, A. Salazar, F. Lee	
<b>A Generic Labeling Scheme for Segmented Cardiac MR Images</b>	45
M. Bister, J. Cornelis, Y. Taeymans, N. Langlois	
<b>Correlation of Cardiac MRI and PET Images Using Lung Cavities as Landmarks</b>	49
R. Kim, T. Aw, S. Bacharach, R.O. Bonow	
<b>Myocardial Bloodflow by PET: Correction for Spillover and Partial Volume</b>	53
S.L. Bacharach, R.O. Bonow, A. Cuocolo, P. Perrone-Filardi, L.-M. Voipio-Pulkki, R.E. Carson, J.A. Frank, S. Maurea, B. Scheffk	
<b>A Three-Dimensional Graph Searching Technique for Cardiac Border Detection in Sequential Images and Its Application to Magnetic Resonance Image Data</b>	57
D.R. Thedens, D.J. Skorton, S.R. Fleagle	

**Session 2**  
**Heart Rate Variability I**  
Solange Akselrod

61

<b>Evaluation of HRV by PP and RR Interval Analysis Using a New Time Delay Estimate</b>	63
P. Laguna, P. Caminal, R. Jané, H. Rix	
<b>Differences in the Atrial, the Ventricular and the Digital Cardiac Rhythm</b>	67
C.A. Swenne, M.J.A. Janssen, J. de Bie, V. Manger Cats, A.V.G. Bruschke	
<b>Analysis of Heart Rate Variations During Sleep: Presence of a Newly Observed Non-Periodic Trapezoidal Waveform</b>	71
D. Sapoznikov, M.H. Luria, Y. Mahler, M.S. Gotsman	
<b>Average Heart Rate, Heart Rate Variability and the Sympathovagal Balance</b>	75
M.J.A. Janssen, C.A. Swenne, J. de Bie, V. Manger Cats, A.V.G. Bruschke	
<b>Spectral Analysis of Heart Rate Variability Signals in Newborns: Physiological and Clinical Aspects</b>	79
M.G. Signorini, O. Agostoni, A. Brina, S. Cerutti, R. di Michele, M. Pagani	

**Session 3**  
**Cardiology Databases**  
Rosalie A. Dunn

83

<b>A Relational Database for Cardiology</b>	85
C. Kruse	
<b>Heartview - An Object-Oriented Knowledge Base to Support Clinical Research in Cardiology</b>	89
B. de F. Leão, T. Timmers, J. van der Lei, E. van Mul	
<b>Computer Assisted Management of Malignant Ventricular Arrhythmias</b>	93
W.A. Dijk, J.H. Kingma, W. van der Velde, K.I. Lie, N.M. van Hemel	
<b>A Database System for Capturing and Reporting Cardiac Catheterization Results</b>	97
J. Buckwold, S.G. Pauker	

**Session 4**  
**Implantable Devices**  
James Roth

101

<b>Statistical Validation of New Template Matching Methods for Detecting Ventricular Tachycardia</b> R.D. Throne, J.M. Jenkins, L.A. DiCarlo	103
<b>Sequential Discrimination of Atrial and Ventricular Tachyarrhythmias</b> D. Mears, K. Pan, G. Xin-rong, N.V. Thakor	107
<b>Wavefront Orientation Effects on Bipolar Epicardial Electrograms</b> S.M. Blanchard, W.M. Smith, W.C. Buhrman, M. Tedder, R.E. Ideker, J.E. Lowe	111
<b>Intraventricular Electrogram Morphology: Effect of Increased Heart Rate with and without Accompanying Changes in Sympathetic Tone</b> C.J. Finelli, P.-C. Li, J.M. Jenkins, R.D. Throne, L.A. DiCarlo	115
<b>Evaluation of the Extended Holter Capabilities of the Prometheus Implantable Research Pacemaker</b> R. Hünen, P. Maison-Blanche, A. Guezennec, R. Urban, N. Bakels, I. Bourgeois, P. Coumel	119

**Session 5**  
**Perfusion Imaging**  
Rudiger Brennecke

123

<b>An Image Processing Algorithm for the Determination of Changes in Coronary Blood Flow from Digital Coronary Angiograms</b> J.T. Cusma, K.G. Morris, A. Chu, L.A. Spero, T.M. Bashore	125
<b>High Resolution Parametric Imaging for the Assessment of Organ Blood Perfusion and Its Dynamics</b> V. Bhargava, G. Hagan	129
<b>Quantitative Angiology on a Macintosh II</b> E. Gronenschild, R. Groothedde, J. Janssen	133
<b>Myocardial Perfusion Imaging Using Contrast Echocardiography</b> M. Halmann, S. Reisner, R. Beyar	137
<b>Parametric Assessment of Myocardial Perfusion by Densitometric Evaluation of Digital Subtraction Coronary Angiograms: A Comparison with Tomographic TL-201 Scintigraphy Results</b> M. Haude, R. Brennecke, R. Erbel, U. Renneisen, M. Lang, D. Eibner, K. Hahn, J. Meyer	141
<b>Automatic Segmentation of Ultrafast Cardiac Flow Scans and RMBF Calculation</b> C.J. Wolfkiel	145

**Session 6**  
**Heart Rate Variability II**  
Donald H. Singer

149

<b>Short and Long Term Variability of Systolic Blood Pressure and Pulse Interval in Intact and Baroreceptor Denervated Cats</b> M. DiRienzo, P. Castiglioni, G. Parati, A.J. Ramirez, A. Pedotti	151
<b>The Role of Renin-Angiotensin and Alpha Control in the Regulation of Blood Pressure in a Normotensive Versus a Hypertensive System</b> S. Eliash, O. Oz, S. Cohen, S. Akselrod	155

<b>Complex Demodulation of Heart Rate Changes During Orthostatic Testing</b>	<b>159</b>
T. Kauta, F. Jager, W.N. Tapp	
<b>Autonomic Impairment in Essential Hypertension in Rats: Representation by a Computerized Model</b>	<b>163</b>
O. Oz, G. Wasserman, S. Eliash, M. Raad, S. Akselrod	
<b>A Comparison between R-R and R-T Variability Signals in Normal and Pathological Subjects</b>	<b>167</b>
S. Cerutti, G. Baselli, M.G. Signorini, M.L. Finocchiaro, F. Lombardi, N. Montano, A. Malliani	
<b>Session 7</b>	
<b>System Evaluation and Certification</b>	<b>171</b>
Christoph H. Zywietz	
<b>ST-Segment Analysis with Ambulatory ECG Monitoring: Are Solid State Recorders Better than Tape Cassettes?</b>	<b>173</b>
T. Brueggemann, D. Andresen, R. Schroeder	
<b>The European ST-T Database: Development, Distribution and Use</b>	<b>177</b>
A. Taddei, A. Biagini, G. Distante, M. Emdin, M.G. Mazzei, P. Pisan, M. Varanini, R.G. Mark, G.B. Moody, L. Braaksma, C. Zeelenberg, C.	
<b>Quality Assurance of Interpretive Electrocardiographs - Development of Testing Services in the European Communities - First Results</b>	<b>181</b>
Chr. Zywietz, V. Mertins, J.L. Willems	
<b>The MIT-BIH Arrhythmia Database on CD-ROM and Software for Use with It</b>	<b>185</b>
G.B. Moody, R.G. Mark	
<b>Left Ventricular Assist System Reliability Testing</b>	<b>189</b>
R.A. Dunn, A.S. Benson	
<b>Session 8</b>	
<b>Distributed Data Management</b>	<b>193</b>
Michael Laks	
<b>A Multiuser Networked System for the Large Scale Study of Coronary Artery Restenosis Using Quantitative and Qualitative Coronary Angiography</b>	<b>195</b>
L.A. Spero, J.D. Hanemann, J.T. Cusma, D.F. Fortin, T.M. Bashore	
<b>Multimedia Communication with ISDN-Technologies - Applications in Radiology and Cardiology Departments</b>	<b>199</b>
A.J. Hewett, J. Schwanke, L. Köhler, P. Jensch, G.-H. Reil, H. Niemann	
<b>CW2000: A Medical Workstation to Support Research in Cardiology</b>	<b>203</b>
E.M. van Mulligen, T. Timmers, A. Langhout, B. de F. Leão	
<b>CADANS: Implementation of a Nationwide Data Network for Cardiology. An Initial Evaluation</b>	<b>207</b>
M.G. Gerritsen, G.T. Meester	
<b>CAESARS: The Cardiac Echo Storage and Retrieval Network System</b>	<b>211</b>
R.G.A. Mulleneers, E.C. Cheriex, W.R.M. Dassen, B.B. Bleijlevens, H.J.J. Wellens, G.T. Meester	
<b>Integrated Cath Lab - Automated Data Acquisition and Transfer</b>	<b>215</b>
M.R. Rombach, U. Solzbach, U. Tittes, A.M. Zeiher, H. Wollschläger, H. Just	

**Session 9**  
**Mechanical Modeling**  
William J. Sanders

219

<b>A Generalized Left Ventricular Dynamic Compliance Model: The Chemo-Mechanical Capacitive Transducer</b> J. Lefevre	221
<b>Extracting New Information from the Shape of the Blood Pressure Pulse</b> K.P. Clark, R.G. Mark	225
<b>Mathematical Modelling of Paired Arterial Stenoses</b> P.R. Johnston, D. Kilpatrick	229
<b>A Computer-driven Control System for Sensing and Adjusting Papillary Muscle Tension in an In-Vitro Model of Mitral Valve Function</b> E.G. Cape, E.R. Gieseking, A. Cagniot, M.S. Simpson, A.E. Weyman, A.P. Yoganathan, R.A. Levine	233
<b>Regional Myocardial Blood Flow: Quantitative Assessment by Computer Analysis of Contrast-enhanced Echocardiographic Images</b> V. Mor-Avi, D. David, Y. Bitton, S. Akselrod	237

**Session 10**  
**Heart Rate Variability III**  
David J. Wilber and Richard I. Kitney

241

<b>Techniques for Analyzing Complexity in Heart Rate and Beat-to-Beat Blood Pressure Signals</b> D.T. Kaplan, M.I. Furman, S.M. Pincus	243
<b>Analysis of Variability: A System for Comparing Classical, Parametric, Adaptive and Wigner-Ville Power Spectral Estimators</b> M. Venturi, F. Conforti, A. Macerata, M. Varanini, M. Emdin, C. Marchesi	247
<b>Impact of Arrhythmias on Heart Rate Variability - Strategies to Deal with Imperfect Clinical Data</b> T. Vybiral, R.J. Bryg, M.A. Maddens	251
<b>The Effect of Controlled Respiration on Parameters of Heart Rate Variability</b> R.J. Bryg, T. Vybiral, M. Maddens	255
<b>Adaptive Cancellation of Respiratory Sinus Arrhythmia</b> U. Wiklund, U. Niklasson, P. Bjerle	259
<b>Use of Recurrence Plots in the Analysis of Heart Beat Intervals</b> J.P. Zbilut, M. Koebbe, H. Loeb, G. Mayer-Kress	263

**Session 11**  
**Diagnostic Electrocardiography and Ischemia**  
Jerome R. Cox, Jr.

267

<b>Neural Networks for ECG Classification</b> G. Bortolan, R. Degani, J.L. Willems	269
<b>Time-related Energy Distribution in Hyperkalemic Repolarisation</b> R.W. Childers, J. Mortara	273

<b>Diagnosis of Ischemia by Continuous ECG-Monitoring</b>	<b>275</b>
D. Engel, J. Silny, G. Rau, M. Rubart, P. Hanrath	
<b>An Algorithm for Prehospital Thrombolysis in Acute MI</b>	<b>279</b>
M.J.M. Bouteren, M.L. Simoons, J.A.M. Hartman, C. Zeelenberg, J. Pool	
<b>3-D Reconstruction of Myocardial Ischaemia from 16 Site Praecordial 24-Hour ST Mapping</b>	<b>283</b>
R.D. Seegobin, R.R. Tinline	
<b>Session 12</b>	
<b>Neural Networks</b>	<b>285</b>
Alan Sahakian	
<hr/>	
<b>A Neural Network to Differentiate Wide-QRS Tachycardias</b>	<b>287</b>
W.R.M. Dassen, R.G.A. Mulleneers, K. den Dulk, J.L.R.M. Smeets, P. Brugada, H.J.J. Wellens	
<b>Tracking Ventricular Arrhythmias with an Artificial Neural Network</b>	<b>291</b>
E.M. Strand, W.T. Jones	
<b>Neural Networks for Improved Automation of Ventricular Activation Mapping</b>	<b>295</b>
J.H. McClelland; N.D. Danieley, C. Cabo, R.E. Ideker, W.M. Smith	
<b>Neural Networks in the Detection of Early Acute Myocardial Ischemia from Canine Echocardiographic Radio Frequency Data</b>	<b>299</b>
K. Chen, K.J. Cios, R.A. Langenderfer	
<b>Neural Network Based Multi Sensor Heart Sound Analysis</b>	<b>303</b>
D. Barschdorff, E. Dorsel, S. Dorsel, T. Dorsel, E. Most	
<b>Extended Coronary Trees by Neural Network Based Fusion of DSA-Sequences and ECT-Images</b>	<b>307</b>
P. Jensch, L. Köhler, A. Hewett, G.-H. Reil, N. Rilinger, H. Niemann	
<b>Session 13</b>	
<b>Coronary Artery Imaging</b>	<b>311</b>
Alan Berson	
<hr/>	
<b>Morphological Enhancement of Coronary Angiograms</b>	<b>313</b>
D.L. Wilson, C. Bertram	
<b>A Knowledge-Based System for the Automatic Quantification of Stenotic Lesions on Angiograms</b>	<b>317</b>
D. Delaere, C. Smets, P. Suetens, A. Aubert, F. Van de Werf	
<b>Validation Study of 3-D Reconstruction of Coronary Arteries</b>	<b>321</b>
J. Wu, Q. Zhang, E. Vogelstein, D.L. Parker	
<b>Three Dimensional Display of the Heart and Coronaries Relating Stenosis Shape and Severity to Regional Function</b>	<b>325</b>
M. Halmann, S. Sideman, J. Lessick, R. Beyar	
<b>Digital Subtraction for Noise Reduction in Intravascular Ultrasound Data</b>	<b>329</b>
M.J. Vonesh, C. Kequing, M. Radvany	
<b>A Computer-aided Analysis System for the Quantitative Assesment of Intravascular Ultrasound Images</b>	<b>333</b>
L. Wenguang, W.J. Gussenhoven, J.G. Bosch, F. Mastik, J.H.C. Reiber, N. Bom	

**Session 14**  
**High Resolution Electrocardiography**  
Edward J. Berbari

337  
Digital Signal Processing  
Digital Filtering

- Use of a Power Law Scaling Relationship to Analyze Signal Averaged ECGs** 339  
J.P. Zbilut, J. Briller, N. Weinstein, W. Weissner

- Detection of Higher Frequency Components at Mid-QRS Stage of Electrocardiogram - A Digital Filtering Approach and Its Possible Relevance to Myocardial Tissue Characterization** 343  
M. Okajima, T. Kawaguchi, T. Suzuki, S. Suzuki

- Adaptive Filtering of High-Resolution ECG Signals** 347  
R. Jané, P. Laguna, P. Caminal, H. Rix

- High Frequency ECG during Reperfusion Therapy of Acute Myocardial Infarction** 351  
S. Abboud, J. Leor, M. Eldar

**Session 15**  
**Electrophysiologic Modeling I**  
Cees A. Swenne

- Tachyarrhythmia Thresholds in a Three-Dimensional Computer Model of a Heart** 357  
M.G. Fishler, R.A. Province, N.V. Thakor

- Patient Oriented Model of Atrioventricular Reentrant Tachycardia and of Its Termination by Overdrive On-Circuit Pacing** 361  
M. Malik, A.J. Camm

- A Computer Simulation of the Time-dependent Conduction Properties of the Atrioventricular (AV) Node** 365  
D. Papadatos, M. Talajic, C. Villemaire, S. Nattel, L. Glass

- Use of Computer Simulation in the Development of an Algorithm for Analysis of Paced Electrocardiograms** 369  
S.E. Greenhut, J.M. Jenkins

**Session 16**  
**Three-Dimensional Ventricular Imaging**  
Geert T. Meester

- Efficient Generation of 3-D Images and Off-Axis Projections Using a PC-Based Parallel-Processing Subsystem** 375  
S.R. Cannon, S.J. Allan

- The Display of 3D MRI Data with Non-Linear Focal Depth Cues** 379  
S.E. Wixon

- ECG-Triggered Snapshot MR Imaging of the Heart** 381  
Y. Liu, S.J. Riederer, D.G. Brown, R.C. Wright, A.E. Holsinger, R.C. Grimm, R.L. Ehman

- Dynamic 3D Reconstruction of the Normal Human Mitral Valve from 2D Echocardiographic Scans** 385  
M.D. Handschumacher, A.J. Sanfilippo, A.E. Weyman, R.A. Levine

<b>Session 17</b>	
<b>Data Compression</b>	<b>389</b>
Andre E. Aubert	
<hr/>	
<b>Compression of Diagnostic Resting Electrocardiograms</b>	<b>391</b>
Chr. Zywietsz, G. Joseph, R. Fischer	
<hr/>	
<b>Karhunen-Loeve Coding of ECG Signals</b>	<b>395</b>
R. Degani, G. Bortolan, R. Murolo	
<hr/>	
<b>Evaluation of Algorithms for Real-time ECG Data Compression</b>	<b>399</b>
C. Lamberti, M. Zagnoni, R. Degani, G. Bortolan	
<hr/>	
<b>Performance Evaluation and Choice Criteria of Data Compression Algorithms by Extensive Test on CSE Database</b>	<b>403</b>
R. Bedini, D. Franchi, G.L. Generali	
<hr/>	
<b>Session 18</b>	
<b>Epicardial Mapping</b>	<b>407</b>
Thomas E. Bump	
<hr/>	
<b>Discrete Smooth Interpolation as an Aid to Visualizing Electrical Variables in the Heart Wall</b>	<b>409</b>
E.V. Simpson, R.E. Ideker, K.M. Kavanagh, C.A. Alverness, S.B. Melnick, W.M. Smith	
<hr/>	
<b>Computerized Vector Mapping of Myocardial Activation</b>	<b>413</b>
N. Kanaan, J. Jenkins, R. Levy, A. Kadish	
<hr/>	
<b>Spatial Filtering of Unipolar Electrograms</b>	<b>417</b>
C. Cabo, J.M. Wharton, R.E. Ideker, W.M. Smith	
<hr/>	
<b>Variation of Cycle Length in Epicardial Electrograms: A Quantification of Chaos of Ventricular Fibrillation Using a Sock Electrode Array</b>	<b>421</b>
P.-W. E. Hsia, K.W. Hellmann, R. Mahmud	
<hr/>	
<b>Session 19</b>	
<b>Wall Motion I</b>	<b>425</b>
Alexander Neumann	
<hr/>	
<b>Cavity Boundary Detection from Sequential Echocardiograms Using a Temporally Adaptive Multilevel Energy Function</b>	<b>427</b>
N.S. Friedland	
<hr/>	
<b>A Nonlinear Multiresolution Approach to Echocardiographic Image Segmentation</b>	<b>431</b>
C.H. Chu, D.H. Razi	
<hr/>	
<b>Developments Towards Real-Time Frame-to-Frame Automatic Contour Detection on Echocardiograms</b>	<b>435</b>
J.G. Bosch, J.H.C. Reiber, G. van Burken, J.J. Gerbrands, A. Kostov, A.J. van de Goor, M.E.R.M. van Daele, J.R.T.C. Roe	
<hr/>	
<b>Automated Left Ventricular Border Determination In Cineangiograms Based on a Dynamic Spider Model</b>	<b>439</b>
N. Fan, B.G. Denys, C.C. Li, P.S. Reddy	
<hr/>	
<b>Automatic Detection of Left Ventricular Endocardium In Cardiac Images</b>	<b>443</b>
K.P. Philip, E.L. Dove, D.D. McPherson, K.B. Chandran	

<b>Session 20</b>	
<b>Noisy ECGs</b>	<b>447</b>
Sergio Cerutti	
<hr/>	
<b>Study on the Influence of a Noisy Environment on the ECG Correlation Dimension Determination; Possible Use for Noise Estimation</b>	<b>449</b>
A. Casaleggio, M. Morando, S. Ridella	
<hr/>	
<b>Frequency Domain Characterization of Artifact and Tachyarrhythmias in the Surface Electrocardiogram</b>	<b>453</b>
L.E. Widman, C.N. Mead, B.L. Pierce	
<hr/>	
<b>Performance of an Arrhythmia Analysis System Based on Hidden Markov Models</b>	<b>457</b>
D.A. Coast, G.G. Cano, S.A. Briller	
<hr/>	
<b>Improved Detection and Classification of Arrhythmias in Noise-Corrupted Electrocardiograms Using Contextual Information</b>	<b>461</b>
S.D. Greenwald, R.S. Patil, R.G. Mark	
<hr/>	
<b>A Comparison of Human Experts and Computer Algorithms in Detecting and Classifying Beats in Noise-Corrupted Electrocardiograms</b>	<b>465</b>
C.W. Chia, S.D. Greenwald, R.G. Mark	
<hr/>	
<b>Session 21</b>	
<b>Body Surface Mapping</b>	<b>469</b>
Rory W. Childers	
<hr/>	
<b>Construction of Body Surface Isoharmonic Maps from Frank XYZ Leads</b>	<b>471</b>
R.M. Arthur, H.D. Ambos, M.E. Cain	
<hr/>	
<b>Electrocardiographic Precordial Interlead Variability in Normal Individuals and Patients with Long QT Syndrome</b>	<b>475</b>
M. Alberti, M. Merri, J. Benhorin, E. Locati, A.J. Moss	
<hr/>	
<b>Knowledge-Based System for Classification of Body Surface Potential Maps</b>	<b>479</b>
F. Komreich, T.J. Montague, P. Smets, P.M. Rautaharju, M. Kavadias	
<hr/>	
<b>Body Surface Isochrone Mapping Indexes in Ventricular Function Evaluation. Ventricular Activation and RMS Time Value</b>	<b>483</b>
A. Aleixo, V. Gil, M. Adão, R. Seabra-Gomes, N. Especial, F. Almeida	
<hr/>	
<b>Non-Invasive Detection of Acute Rejection after Cardiac Transplantation by Means of Body Surface Potential Mapping</b>	<b>487</b>
L. Vogt, M. Sigmund, C.J. Kirkpatrick, J. Silny, H. Völker, G. Rau, P. Hanrath, S. Effert	
<hr/>	
<b>Session 22</b>	
<b>Wall Motion II</b>	
Michael V. Green	<b>491</b>
<hr/>	
<b>Automated Detection of Noninvasive Magnetic Resonance Markers</b>	<b>493</b>
D.J. Fisher, J.C. Ehrhardt, S.M. Collins	
<hr/>	
<b>A Robust Optical Flow Assessment of the Epicardial Contractility in Cine-Angiography</b>	<b>497</b>
J. Meunier, M. Verreault, M. Bertrand, M.G. Bourassa	

**Session 23**  
**Arrhythmia Analysis**  
Janice M. Jenkins

**501**

- Simultaneous QRS Detection and Feature Extraction Using Simple Matched Filter Basis Functions** 503  
D.T. Kaplan

- Algorithms for Improved Detection of Supraventricular Arrhythmias** 507  
S.G. Artis, G.B. Moody, R.G. Mark

- P-Wave Trending: A Valuable Tool for Documenting Supraventricular Arrhythmias and AV-Conduction Disturbances** 511  
J. de Bie

- Changes in the Surface ECG Frequency Spectrum during the Onset of Ventricular Fibrillation** 515  
R.H. Clayton, A. Murray, R.W.F. Campbell

- Frequency Analysis: A Potential Method to Differentiate Ventricular Fibrillation of Various Etiologies** 519  
P.-W. E. Hsia, S.R. Jolly, W.C. Reeves, R. Mahmud

**Session 24**  
**Electrophysiologic Modeling II**  
Harry A. Fozard

**523**

- A Cellular Automata Model of Electrical Propagation in Cardiac Tissue** 525  
K.D. Bollacker, C.A. Alferness, W.M. Smith, R.E. Ideker

- Effects of Uniform Anisotropy on Wavelet Fractionation and Electrogram Simulations in a Computer Model of Fibrillation** 529  
H.J. Sih, A.V. Sahakian, J.M. Baerman, S. Swiryn

- Computer Model of Myocardial Electrotropic Interactions and Its Applications** 533  
M. Malik, A.J. Camm

- Defibrillation Thresholds in a Three-Dimensional Computer Model** 537  
R.A. Province, M.G. Fishler, N.V. Thakor

**Poster Session**

**541**

- ECG Filter Based on Local Maximum-A-Posteriori Technique** 543  
S.S. Furui, M.A. Gutierrez

- Multiresolution Representation and Analysis of ECG Waveforms** 547  
F. Jager, I. Koren, L. Gyergyek

- NHLBI/NIH Supported Research Related to Computers and Heart and Vascular Diseases** 551  
A.S. Berson

- Neural Network for Automatic Anomalous QRS Complex Detection** 553  
A. Casaleggio, M. Morando, S. Ridella

- Diastolic Intraventricular Pressure Gradient Analysed by Digital Signal Processing** 557  
A. Ronaszeki, A.E. Aubert, Z. Wu, H. Ector, H. de Geest

<b>A New Algorithm to Calculate the Rheobase, the Chronaxie and the Charge at the Electrode-Myocardial Interface</b>	<b>561</b>
Z.M. Benedek, S. Furman	
<b>Structure of a Multidimensional Relational Database Optimized for Daily Clinical Use and Decision Support in Cardiology Departments</b>	<b>565</b>
D. Cianflone, O. Carandente, S.L. Chierchia	
<b>Area-of-Difference Methods for Detection of Ventricular Tachycardia Using Morphology</b>	<b>569</b>
R.D. Throne, J.M. Jenkins, L.A. DiCarlo	
<b>Real-Time Computer Acquisition, Analysis, and Display of Electrophysiology Studies</b>	<b>573</b>
S.E. Greenhut, R.S. MacDonald, J.M. Jenkins, R. Arzbaecher	
<b>Curvature Analysis of Ventriculograms: How Useful Is It to Assess Progression of Left Ventricular Remodeling and Dysfunction</b>	<b>577</b>
C. van Eyll, H. Pouleur, J. Raigoso, O. Gurné, A.A. Charlier, M.F. Rousseau	
<b>Computer Automated Non-Invasive Arterial Pressure Measurement</b>	<b>581</b>
J.N. Carter, E.M. Herrold, N. Magid, R. Goldweit, J.S. Borer	
<b>Modeling the Treatment Scheme of Sustained Ventricular Tachycardia with a Bayesian Belief Network</b>	<b>585</b>
A. Gerevini, W.J. Irler, R. Antolini, G. Vergara, F. Furlanello	
<b>Measurement of Left Ventricular Ejection Fraction (EF) by Densitometry from Digital Subtraction Angiography</b>	<b>589</b>
T. Machnig, B. Eicker, K. Barth, H. Lehmkuhl, K. Bachmann	
<b>Intraluminar Doppler-Sonography: A New Device for Data Analysis and Its "In Vitro" Test</b>	<b>593</b>
T. Roth, R. Brennecke, R. Erbel, J. Meyer, W. van Seelen	
<b>A Telemedicine Approach for Hypertension Care</b>	<b>595</b>
M.T. Arredondo, F. Del Pozo, E. Gómez, T. Barranquero, M. Lallana, M.J. Rodriguez	
<b>Efficient Performance of Neural Network Models as Artificial Intelligence Prediction Tools in Cardiology</b>	<b>599</b>
D. Cianflone, O. Carandente, M. Carlino, C. Meloni, S.L. Chierchia	
<b>Automated Contour Detection of the Left Ventricle in Short Axis View and Long Axis View on 2D Echocardiograms</b>	<b>603</b>
L. Maes, D. Deleare, P. Suetens, A. Aubert, F. van de Werf	
<b>Simulation and Computer Graphics in Medical Education: A Visual Presentation Metaphor</b>	<b>607</b>
M.S. Begeman, L.T. Andrews, J.W. Klingler, K.Y. Szwajkun, C.A.C. Baptista, J. Ziess, R.F. Leighton	
<b>Signal Averaged Electrocardiograms: A Comparative Study of Two Recording Devices</b>	<b>611</b>
J.F. Moran, L. Larson, D. Wilber	
<b>Quantification of Asynchronous Displacement of Heart Borders</b>	<b>613</b>
E.L. Bolson, F.H. Sheehan	
<b>Estimation of Jet Flow Rate from Doppler Proximal Velocity Acceleration: Theoretical Predictions from Conformal Mapping of Inviscid Flow Fields</b>	<b>617</b>
J.D. Thomas, L. Rodriguez, R.A. Levine, A.E. Weyman	
<b>Adaptive Filtering of ECG Signal for Deriving Respiratory Activity</b>	<b>621</b>
M. Varanini, M. Emdin, F. Allergini, et al	
<b>Computerized Network Organization Design for Clinical Patient Data Management of a Cardiology Department</b>	<b>625</b>
E. Cervesato, G.L. Nicolosi, D. Zanuttini	