

IEEE 1981 Frontiers of Engineering in Health Care

September 19-21, 1981

IEEE 1981 FRONTIERS OF ENGINEERING IN HEALTH CARE

B. A. Cohen, Editor

**September 19-21, 1981
Shamrock Hilton Hotel
Houston, Texas**

**"Frontiers of Engineering in
Health Care"
with
"Frontiers of Computers in Medicine"**

**The 3rd Annual Conference
of the
Engineering in Medicine
and Biology Society
of the
Institute of Electrical
and Electronics Engineers**

IEEE Catalog No. 81CH1621-2
Library of Congress Catalog Card No. 80-85144

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, 21 Congress St., 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 E. 47 St., New York, NY 10017. All rights reserved. Copyright © 1981 by The Institute of Electrical and Electronics Engineers, Inc.

Message from the President of the IEEE Engineering in Medicine and Biology Society

These national and international conferences are the highlight of our activities as a technical and professional society of the IEEE. This is our third conference year, and we hope it will contribute to the emergence of engineers in health care delivery. As the organizers and sponsor of this conference, we have made every possible effort to have it serve as a focal point for the latest developments involving technology in health care. Our technical committees, publication editors, and administrative committee members (AdCom) have planned for the past year to bring together the relevant research efforts, the clinical developments, and the industrial applications. Key people have been invited to organize the sessions and workshops. Many invited papers have been included to ensure the proper balance in the sessions. Tutorials and workshops have been included as part of the regular conference program. The full conference papers are published in these Conference Proceedings, and the abstracts of each paper were published in the August issue of our EMBS Transactions.

It is a gratifying moment to see our EMBS Society meet and work together at our own annual conference. May I welcome you to our conference, and I hope that your interaction with the other participants will lead to a more effective communication for our Society.

I would like to express my gratitude to those who have labored to bring this program together; and, in particular, to Bernard Cohen, Ph.D. for being the program chairman for the EMBS conference and Robin Lake, Ph.D. for being the program chairman for the CompMed conference.

Mort Schwartz, Ph.D.
President, EMBS

3rd Annual EMBS Conference Program

1981 CONFERENCE PLANNING COMMITTEE

Program Chairman,
Publication Chairman,
Vice President for
Member & Chapter
Activities—IEEE/EMBS

Assoc. Program Chairman,
Region 4 Representative—
IEEE/EMBS

Conference Coordinator,
President—IEEE/EMBS

Publicity Chairman,
Newsletter Editor—
IEEE/EMBS

Finance Chairman,
Secretary/Treasurer—
IEEE/EMBS

Vice President for
Technical Activities—
IEEE/EMBS

Past President—
IEEE/EMBS

Past President—
IEEE/EMBS
Division 6 Director,
IEEE

Bernard Allan Cohen, Ph.D.
Dept. of Neurology
The Medical College of Wis.
5000 W. National Ave.
Milwaukee, WI 53193

Vincent R. Canino, Ph.D.
Biomedical Engr. Program
Milwaukee School of Engr.
Milwaukee, WI 53201

Morton D. Schwartz, Ph.D.
Electrical Engr. Dept.
California State Univ.
Long Beach, CA 90840

Allen W. Hany,
D.V.M., Ph.D.
Dalton Research Center
Univ. of Missouri-Columbia
Research Park
Columbia, MO 65201

Dean C. Jeutter, Ph.D.
Dept. of Electrical Engr.
Marquette Univ.
Milwaukee, WI 53233

Lee E. Ostrander, Ph.D.
Center for Biomedical Engr.
Rensselaer Polytech Inst.
Troy, NY 12181

Eli Fromm, Ph.D.
Biomedical Engr. & Science
Program
Drexel Univ.
Philadelphia, PA 19104

Thelma Estrin, Ph.D.
Brain Research Institute
Univ. of California
Los Angeles, CA 90024

Ron Bahr
U Texas
Austin, TX

Joseph Battocletti
Med Col Wis
Milwaukee, WI

Joseph Bronzino
Trinity Col
Hartford, CT

Everette Burdette
Georgia Inst Tech
Atlanta, GA

Barry Feinberg
Purdue U
West Lafayette, IN

Eli Fromm
Drexel U
Philadelphia, PA

Glen Gerhard
U New Hampshire
Durham, NH

Alan Gevins
Langley Porter Inst
San Francisco, CA

Samuel Goldman
Picker Corp.
Northford, CT

Gerald Goodman
Texas Tech Med Ctr
Houston, TX

Allen Hahn
U Missouri
Columbia, MO

Dov Jaron
Drexel U
Philadelphia, PA

William Jarzembksi
Texas Tech U
Lubbock, TX

Dean Jeutter
Marquette U
Milwaukee, WI

Lawrence Katz
Rensselaer Polytech
Troy, NY

Perry Ktonas
U Houston
Houston, TX

Robin Lake
Univ. Hospital
Cleveland, OH

Charles Laszlo
U British Col
Vancouver BC

Ken Mylrea
U Arizona
Tucson, AZ

Vince Canino
Milw School Engr
Milwaukee, WI

Bernard Cohen
Med Col Wis
Milwaukee, WI

Ken Cummins
Stanford U Med Ctr
Stanford, CA

Chris Druzalski
California State U
Long Beach, CA

Lee Ostrander
Rensselaer Polytec.
Troy, NY

Theo Pilkington
Duke U
Durham, NC

Al Potvin
U Texas
Arlington, TX

Blair Rowley
Texas Tech U
Lubbock, TX

Subrata Saha
LSU Med Ctr
Shreveport, LA

Sergio Salles-Cunha
Med Col Wis
Milwaukee, WI

Arthur Sherwood
Texas Inst Rehab
Houston, TX

Henry Stark
Rensselaer Polytec
Troy, NY

Andrew Szeto
Louisiana Tech
Ruston, LA

Willis Tompkins
U Wis
Madison, WI

Cedric Walker
Tulane U
New Orleans, LA

George Webb
Johns Hopkins
Baltimore, MD

John Webster
U Wis
Madison, WI

Herman Weed
Ohio State U
Columbus, OH

IEEE Engineering in Medicine and Biology Society

The Engineering in Medicine and Biology Society of the IEEE (IEEE/EMBS) is an association of 7,000 members concerned with the application of engineering science and methodology to biology, medicine, and health care delivery systems.

EMBS is a Society within the umbrella framework of the Institute of Electrical and Electronics Engineers (IEEE) offering identification with the world's largest professional engineering organization of 180,000 members. Activities of the IEEE/EMBS include:

Publications—The IEEE Transactions on Biomedical Engineering is a monthly publication of reviewed articles reporting original research and application and development, short communications to disclose new ideas, and tutorials and reviews. The EMBS Newsletter is published quarterly and contains news and events of current interest to biomedical engineering professionals.

Conferences—Conference Proceedings are widely distributed and indexed through IEEE and may be purchased at member's prices from IEEE. The Society also cosponsors and/or cooperates in other national and regional biomedical conferences.

Technical and Professional Committees—EMBS Committees organize conference sessions, workshops and special activities on behalf of the Society. Technical Committees include: bioelectric phenomena, clinical engineering, medical instrumentation, prosthetic and sensory aids, signal processing and information handling, transducers and devices, and biomaterials. Professional Committees include: awards, biomedical coordination, education, ethics, membership, professional activities, publications, standards, government affairs, and industrial relations. In addition, EMBS participates, through appointed delegates, in other national bodies such as ANSI and NFPA as well as in broad based IEEE Technical Committees addressing such issues as energy, ocean engineering, environmental quality, man and radiation, and social implications of technology.

Regional Councils and Chapters—Society members have the opportunity to exchange technical and professional information with colleagues in their same geographic area through meetings and activities of 7 EMBS Regional Councils and 33 Chapters. Membership in these geographically organized subdivisions is an automatic component of Society Membership.

Membership in IEEE/EMBS is open to all qualified persons in grades designated student, senior member, fellow, and affiliate. Biomedical Professionals who wish to join EMBS but not join the IEEE umbrella organization may do so as affiliate members of EMBS. Affiliate members are accorded the opportunities of participation in all EMBS programs and activities as planned and administered by the EMBS elected Administrative Committee (AdCom).

Author Index

Abouelnour, AM	55	Diamant, NE	85
Abuelnasr, B	55	Diller, K	105
Ahmed, AS.		Druzgalski, CK	383
Akutsu, T.	49	Dujovny, M	117
Anderson, P.	248	Ehrhardt, J	97
Antonich, FJ	145	El-Cherif, YS	132
Ary, JP.	182	El-Mahdi, AM	102
Astrinsky, EA.	273	El-Sharkawy, TY	85
Aunon, JI.	212	Evans, WD	381
Balasubramanian, R	234	Everette, RL.	49
Bardakjian, BL	85	Eysholdt, U	306
Barie, PS.	253	Fender, D	182
Barr, RE	290	Findl, E.	148
Basset, AL	223	Forrest, L.	71
Battocletti, JH.	145, 159, 163	Frank, TP	13
Becker, R.	220	Fukada, E	220
Benedek, M	440	Fuqua, JM	43
Berger, R.	64	Furman, S	273, 440
Black, J	30	Gallagher, DD	429
Bonte, FJ.	395	Gallagher, RR	20, 429
Bourland, JD	1	Gaona, JI	51
Bregman, D	37	Gatti, EF	117
Brenman, HS.	318	Gaumond, RP	69
Brennan, T	69	Geddes, LA.	1
Brickley, JJ	192	Gersch, W	196
Brighton, CT	30	Gevens, AS.	174
Brotherton, T.	196	Glick, KL	248
Brown, OS.	64	Golding, L.	33
Burelli, C	277	Grattoni, E	277
Canino, VR	334	Green, DM	105
Carpenter, WA.	253	Griffiths, C.	148
Carr, KL	102	Gross, D.	240
Castillo, HT	263	Gustafson, DE	267
Cervesato, E	277	Guthermann, H	148
Chambers, JA	43	Halbach, RE	145, 159
Clagnaz, M	330	Harasaki, H	33
Cohen, SR.	37	Harrison, BX.	435
Collins, S	97	Hayes, J.	381
Conti, JC.	148	Hingorani, R.	89
Coppola, R	207	Hogan, HA	313
Cornwell, AC	127	Hogan, N.	3
Cramer, J.	97	Hyman, WA	364
Creel, EE.	429	Ideker, R	259
Crosier, WG.	71	Igo, SR	43
Cullen, J.	220	Jacobs, GB.	33
Cummins, KL.	187, 419	Jaffe, DL	326
Cunningham EA.	3	Jarzembski, WB	246, 377, 379
Darcey, T.	182	Jensen, T	302
David, Y	121	Jones, K	71
Demer, L	139	Kamel, R	55
Deutsch, S	60	Kaskel, P	37

Katona, PG	255
Katz, P	318
Keil, OR	321, 373
Kim, CS	24
Kim, SI	24
Kim, Y	8, 424
Kim, YI	281
Kiraly, RJ	33
Knapp, RB	121
Knox, T	159
Kohl, F.	16
Koliner, C	121
Kondraske, GV.	404
Koogle, TA	326
Kort, JS	223
Kossovsky, N	117
Kovacs, SG	123
Kurtz, R	148
Kwee, H.	386
Kyle, JT	390
La, WH	326
Lake, R.	451
Lastimosa, AC.	297
Laxer, C	259
Laxinarayan, S	127
Lazar, D	82
Lee, HC.	93
Leifer, LF	326
Leung, CH.	93
Levin, HS.	
Liepsch, D	142
Lin, JH.	69
Liu, HH.	281
Louie, H	330
Love, JT	51
Lowry, D	318
Marino, AA	220
Marino, P.	277
Marleau, RS.	424
Marmarou, A.	127
McDonnell, W	390
McDowell, FH	403
McGee, MG	43
McGillem, CD	212
McInnis, BC	49
Messinger, D	290
Milch, P	148
Mills, O	127
Min, BG	24
Morgan, RJ	310, 346
Neal, WA	121

Nelson, K	346
Newell, JC	253
Nicoloski, GL	277
Norman, JC	43
Norwood, P	290
Nose, Y	33
Nowack, WJ	58
Olcaytug, F	16
Ostrander, LE	253
Ostroy, L	360
Page, WR	391
Palem, K	290
Paloski, WH	253
Parker, RW	273
Parkey, RW	395
Patrick, J	294
Paul, I	89
Pearce, JA.	1
Penney, BC.	169
Perlin, A	117
Peters, BH.	
Pienkowski, D	219
Pilkington, TC.	248
Pollack, SR	219
Pollak, VA.	230, 238
Pomalaza, CA.	212
Pond, M	228
Potvin, AR.	404, 409
Potvin, JH.	409
Pourrias, BM.	446
Prohaska, O	16
Reich, T.	435
Rigby, H.	321
Roberts, R.	386
Roger, L.	390
Rosen, R.	
Rosenfeld, J.	302
Roshwan, AH	
Rusinek, H.	435
Rusinko, JB	76
Saha, S	228
Salles-Cunha, S	
Sances, A	145, 159, 163
Sanderson, AC	201
Sarna, S.	132
Sato, K	113
Sauter, M	386
Schmalzel, JL	20
Schneider, GT	310
Schreiner, C.	306
Schwartz, H	318

Schwartz, MD	336
Schmalzel, JL	20
Scott, RN	234
Sepulveda, NG	76
Seshia, SS	294
Setton, JJ	446
Shaeffer, J	102
Shin, H	286
Shturman, L	377, 379
Shwedyk, E	234
Simard, JM	310
Smith, DL	451
Snow, JL	33
Solie, TN	346
Solomon	82
Sorour, MH	55
Sosoures, G	336
Spadaro, JA	215
Spence, JD	355
Stark, H	89
Stern, KS	255
Stimmel, LY	37
Stokely, EM	395
Strope, E	148
Struble, E	390
Sukalac, RW	33
Syndulco, K	409
Szeto, A	313
Takaya, K	113
Targa, S	277
Thakor, NV	397, 438
Tompkins, WJ	424, 438
Tourtellotte, WW	404
Turbes, CC	310, 346

Turner, SA	43
Twyman, TE	297
Uematsu, S	154
Uozumi, T	230
Vollmer, R	16
von Maltzahn	137
Wackenhut, N	117
Wald, A	351
Walker, BK	355
Wan, QX	238
Wang, JC	49
Wang, JY	267
Ward, B	336
Weber, D	123
Webster, DD	415
Webster, JG	397
Weed, H	386
Weitzman, ED	127
Wheeler, HB	169
Williams, WS	240
Willsky, AS	267
Wood, SL	419
Woods, JW	89
Wyss, UP	230
Yang, A	154
Yarnoz, MD	123
Yin, F	139
York, DH	302
Youdin, M	330
Young, F	64
Yun, JH	24
Zanuttini, D	277
Zingg, W	369

Key Word Index to Titles

Acoustic Brainstem Response	69	Data Base	440
Action Potentials	248	Date Acquisition	429
Auditory Evoked potential	310	Doppler Velocity Pat. Cereb.	355
Auditory Evoked Responses	306	Dynamic Sensor	117
Biolized Cardiac Prosthesis	33	EEG Activity, Background	290
Blood Flow Measurement		EEG, Analysis of the	286
Body Model	8	EEG, Epileptic	294
Bone Formation, Electret-Induced	220	Electrical Sources	182
Bone Grafts Stimulation, Autoclaved	228	Electroarteriography	148
Bone, Streaming Potential Wet	240	Electro-Gastrograms	
Brain Blood Perfusion	395	Electrode, Guarded	20
Brain Movements	16	Electromagnetic Flowmetry	163
Breath-Controller	390	Electrotactile Sensation	82
Canine Myocardium	139	Endogenous Electricity	219
Cardiac Catheterization, Left Ventricular	277	Energy Conservation	360
Cardiac Rhythm Interpretation	267	Environmental Control System	321
Carotid Artery Volume Flow	154	Evoked Potential Processing	187
Cerebral Activity	302	Evoked Potentials	192
Cerebral Blood Flow	159	" "	196
Clinical Engineering	351	" "	207
" "	369	" "	212
" "	373	Filter Design	424
Clinical Engineering Assessment	364	Flow Investigation Models	142
Clinical Engineering Education	336	Focal Accuracy	64
Clinical Environment	377	Gait Analysis, 3D	230
Cognition	174	Gastrointestinal Signals	132
Computer Algorithm	253	Haar Trans. Sleep-Apnea Stud.	127
Computer Planimetry Perfusion	446	Health Care Engr. Model	246
Constrained Deconvolution	297	Heart Sounds, Acoustic	386
Cortex, Visual	60	Heart, Artificial	49
Current Stimulation	30	High Fidelity ECG	263

Impedance Plethysmography	169	Polynomials, Energy Density	137
Insulin Delivery	51	Pulmonary Diagnosis	383
Intra-Aortic Balloon	37	Pulsing Electromag. Fields	223
Intracranical Pressure	391	Quadriplegic, High-Level	334
Kinetics, Model Glucose	24	Radionuclide Images	97
Labile Bioelectric Rhythm	85	Revocalization	318
Macromolecular Leakage	105	Self-Tuning Regulator	255
Magnetically Actuated Implantable	123	Silver Electrodes	215
Measuring Halothane	346	Simulator	313
Medical Microprocessors	451	Skeletal Force Gen., Models	234
Membrane Module Intractable Ascites	55	Sperm Cells	113
Microcomputer	438	Synchronization Motor Units	238
Microcomputer Controlled	326	Technical Manager	379
Modeling EEG Evoked Potentials	201	Thalamocortical Interactions	58
Modeling Thoracic Spinal Cord	76	Thermal Profiles of Breast	102
Multicounter	435	Tomography, Computed	93
Myocardial Contractability		Tomography, Computerized	89
Myocardial Stimulation	1	Transducer, Flow Through	13
Myoelectric Signal	3	Unipolar Epicardial QRS Poten.	259
Nerve Refractory	419	Ventricular Assist System	43
Neurologic Examination		Vestibulo-Spinal Hoffmann Reflex	71
Neurologic Function	404	Wheelchairs, Powered	330
" "	409		
Neurological Deficits	96		
Neuromuscular Bioelectric Events	281		
Nuclaeer Magnetic Resonance	145		
Optimal QRS Detector	397		
Pacing Threshold	273		
Parkinson's Disease	415		
Perfusion Index	121		
Periphral Vascular Flow	381		

**IEEE 1981
FRONTIERS OF ENGINEERING
IN HEALTH CARE**

Table of Contents

Myocardial Stimulation with Ultra-short Duration Stimuli	1
Geddes, LA; Pearce, JA and Bourland, JD	
Effects of Tissue Layers on the Surface Myoelectric Signal	3
Cunningham, EA and Nogan, N	
A Three-Dimensional Modifiable Body Model for Biomedical	8
Applications Tompkins, WJ; Kim, Y and Webster, JG	
A Flow-Through Transducer for Biomedical Applications	13
Frank, TP	
The Recording of Brain Movements on Rabbits	16
Prohaska, O; Kohl, F; Olcaytug, F; Vollmer, R and Szirmai, I	
What are the Limitations of the Guarded Electrode Technique?	20
Schmalzel, JL and Gallagher, R	
Equivalent Circuit Model of Glucose Kinetics	24
Yun, JH; Min, BG; Kim, SI and Kim CS	
Recent Experience in Direct Current Stimulation of Non-Unions	30
Black, J and Brighton, CT	
Current Status of the Biolized Cardiac Prosthesis	33
Sukalac, RW; Kiraly, RJ; Snow, JL; Takatani, S and Jacobs, GB Harasaki, H; Golding, L and Nose, Y	
Advances in Intro-Aortic Balloon Technology:	37
the Percutaneous Approach Bregman, D; Cohen, SR; Kaskel, P and Stimmel, LY	
Development and Evaluation of an Implantable Long-Term Electrically . . .	43
Actuated Left Ventricular Assist System THI/Gould LVAS McGee, MG; Fuqua, JM; Igo, SR; Turner, SA; Chambers, JA and Norman, JC	
Automatic Controls for the Artificial Heart	49
McInnis, BC; Everett, RL; Wang, JC and Akutsu, T	
An Implantable Insulin Delivery System	51
Love, JT and Gaona, JI	
Functional Analysis & Design Features of a Dual Membrane	55
Module System for the Treatment of Intractable Ascites Abuelnasr, M; Kamel, R; Sorour, MH and Abouelnour, AM	
Mathematical Interrelationship Between Ventricular Pressure	
and Myocardial Contractibility Roshwan, AH and Ahmed, AS	

A Model of Thalamocortical Interactions: the Attenuation Ratio	58
Nowack, WJ	
A Simplified Model of the Input Layers of the Visual Cortex	60
Deutsch, S	
Measuring the Eye's Focal Accuracy; A Heuristic Approach	64
Brown, OS; Young, F and Berger R	
Inferred Patterns of Surface Potential Distribution on the	69
Head of Cat During the Acoustic Brainstem Response	
Gaumond, RP; Lin, JH and Brennan, T	
A Microcomputer-Based Data Acquisition, Display, and Control	71
System for Vestibulo-Spinal Hoffmann Reflex Experiments	
Crosier, WG; Forrest, L and Jones, K	
Finite Element Modeling of Potentials within the Human Thoracic	76
Spinal Cord due to Applied Electrical Stimulation	
Rusinko, JB; Walker, CF and Sepulveda, NG	
Frequency Response of the Electrotactile Sensation and Pain	82
Threshold	
Solomonow, M and Lazar, D	
On a Population of Excitable Synthesized Relaxation Oscillators	85
Representing a Labile Bioelectric Rhythm	
Bardakjian, BL; El-Sharkawy, TY and Diamant, NE	
Experimental Investigation of Computerized Tomography by Direct	89
Fourier Inversion	
Stark, H; Woods, JW; Paul, I and Hingorani, R	
Effectiveness of Interpolation in the Time Domain for Computed	93
Tomography of Moving Objects	
Leung, CH and Lee, HC	
Second Harmonic Analysis in the Assessment of Ventricular	97
Contraction Patterns from Radionuclide Images	
Collins, S; Ehrhardt, J and Cramer, J	
Microwave Radiometry Thermal Profiles of Breast and Drainage	102
Lymph Node Areas	
Shaeffer, J; El-Mahdi, AM and Carr, KL	
An In-Vitro Experimental Model for Quantifying Macromolecular	105
Leakage	
Green, DM and Diller, K	
Motility Evaluation of Bull's Sperm Cells by Computer Controlled	113
Video Techniques	
Takaya, K and Sato, K	

A Clinically Useable Variable Depth Dynamic Sensor for	117
Determining the Compressive Forces Exerted by Surgical Vascular Clips	
Dujovny, M; Perlin, A; Kossovsky, N; Wackenhut, N and Gatti, EF	
Perfusion Index Using Transcutaneous PO ₂ in Post-Cardiac Surgery	121
David, Y; Koller, C; Neal, WA and Knapp, RB	
Magnetically Actuated Implantable Left Ventricular Assist Device	123
Kovacs, SG; Weber, D and Yarnoz, MD	
Haar Transform Application in Sleep - Apnea Studies of Infants	127
Laxminarayan, S; Mills, O; Cornwell, AC; Marmarou, A and Weitzman, ED	
Parametric Spectral Estimation of Gastrointestinal Signals	132
El-Cherif, YS and Sarna, S	
Determination of Energy Density Polynomials for Arterial	137
Walls by a New Numerical Method	
von Maltzahn, WW	
Passive Biaxial Stress-Strain Properties of Excised Canine	139
Myocardium	
Demer, L and Yin, F	
Flow Investigation on Artery Models with Newtonian and Non-	142
Newtonian Fluids	
Liesch, D	
Review of Technics for Blood Flow Measurement	
Salles-Cunha, S	
A Nuclear Magnetic Resonance Non-Invasive Leg Blood Flowmeter	145
Battocletti, JH; Halbach, RE; Sances, A and Antonich, FJ	
Electroarteriography: Non-Invasive Blood Velocity Determination	148
Conti, JC; Strope, E; Guthermann, H; Griffiths, C; Milch, R; Findl, E and Kurtz, R	
Transcutaneous Measurement of Carotid Artery Volume Flow by	154
an Ultrasonic Device	
Uematsu, S and Yang, A	
Techniques for Measurement of Regional Cerebral Blood	159
Flow Using NMR	
Halbach, RE; Battocletti, JH; Know, T and Sances, A	
Non-Invasive Electromagnetic Flowmetry	163
Salles-Cunha, S; Battocletti, JH; Towne, JB and Sances, A	

An Overview of the Theory and Some Applications of Impedance	169
Plethysmography	
Penney, BC and Wheeler, HB	
Dynamic Brain Electrical Patterns of Cognition	174
Gevis, AS	
Locating Electrical Sources in the Human Brain	182
Ary, JP; Fender, D and Darcey, T	
Evoked Potential Processing: Applications of Linear	187
Estimation and Detection Theory	
Cummins, KL	
Insights from Information Theory Concerning Human Sensory	192
Evoked Potentials	
Brickley, JJ	
Where is the Information for Discrimination in Evoked Potentials?	196
Some Preliminary Observations.	
Gersch, W and Brotherton, T	
Hierarchical Approaches to Modeling EEG and Evoked Potentials	201
Sanderson, AC	
Nonlinear Analysis Applied to Human Evoked Potentials	207
Coppola, R	
Preprocessing for Improved Classification of Evoked Potentials	212
McGillem, CD; Aunon, JI and Pomalaza, CA	
Antibacterial Effects of Silver Electrodes	215
Spadaro, JA	
Endogenous Electricity in Bone	219
Pollack, SR and Pienkowski, D	
Electret-Induced Bone Formation in Rats	220
Marino, AA; Cullen, J; Becker, R and Fukada, E	
The Role of Pulsing Electromagnetic Fields in Orthopaedic	223
Surgery	
Kort, JS and Basset, AL	
Healing of Autoclaved Bone Grafts with Direct Current	228
Stimulation A Preliminary Investigation	
Saha, S and Pond, M	
3D Gait Analysis Using Simple and Inexpensive Data Acquisition	230
Pollak, VA; Wyss, UP and Uozumi, T	
Two Models of Skeletal Force Generation	234
Shwedyk, E; Balasubramanian, R and Scott, RN	

Synchronization of Motor Units During Voluntary Contraction	238
Under Physiological Conditions.	
Pollak, VA; Uozumi, T and Wan, QX	
Streaming Potential or Piezoelectricity in the Electro-	240
mechanical Response of Wet Bone?	
Williams, WS and Gross, D	
A General Model for Health Care Engineering Organizations	246
Jarzembski, WB	
The Utilization of Action Potentials to Assess the Mechanical	248
State of Myocardium	
Glick, KL; Pilkington, TC and Anderson, P	
A Computer Algorithm for Calculations of P50 from a Single	253
Blood Sample	
Ostrander, LE; Paloski, WH; Carpenter, WA; Newell, JC and	
Barie, PS	
Automated Blood Pressure Control Using a Self-Tuning Regulator	255
Stern, KS; Walker, BK and Katona, PG	
Estimation of Myocardial Infarction from Unipolar Epicardial	259
QRS Potentials	
Laxer, C; Pilkington, TC and Ideker, R	
High Fidelity ECG; A Non-Invasive Low Cost Method for Early	263
Detection of Heart Disease	
Castillo, HT	
Cardiac Rhythm Interpretation Using Statistical P and R Wave	267
Analysis	
Gustafson, DE; Wang, JY and Willsky, AS	
Development of a Graphical Method for Estimating Pacing	273
Threshold	
Astrinsky, EA; Parker, B and Furman, S	
A Framework for Three-Dimensional Time Varying Reconstruction	277
of the Human Left Ventricle from Cardiac Catheterization and	
2D-Ultrasound Technique	
Zanuttini, D; Nicolosi, GL; Marino, P; Burelli, C; Grattoni, E	
Cervesato, E and Targa, S	
Real Time Data Acquisition and Analysis of Neuromuscular	281
Bioelectric Events Using a Microcomputer System	
Liu, HH; Van Landingham, KE and Kim, YI	
Analysis of the EEG During Mental Activity Using Multiple	286
Time-Domain Parameters	
Barr, RE; Shin, H and Welch, AJ	