2022 Computing in Cardiology (CinC 2022)

Tampere, Finland
4-7 September 2022

Pages 1-581

IEEE Catalog Number: CFP22CAR-POD
ISBN: 979-8-3503-1013-9

****** This is a print representation of what appears in the IEEE Digital Library. Some format issues inherent in the e-media version may also appear in this print version.***

IEEE Catalog Number:	CFP22CAR-POD
ISBN (Print-On-Demand):	979-8-3503-1013-9
ISBN (Online):	979-8-3503-0097-0
ISSN:	2325-8861

Additional Copies of This Publication Are Available From:

Curran Associates, Inc
57 Morehouse Lane
Red Hook, NY 12571 USA
Phone: (845) 758-0400
Fax: (845) 758-2633
E-mail: curran@proceedings.com
Web: www.proceedings.com

TABLE OF CONTENTS

Heart Pulse Demodulation from Emfit Mattress Sensor Using Spectral and Source Separation Techniques 1
Jose M Perez-Macias, Alpo Värri, Sari-Leena Himanen, Mirja Tenhunen, Jari Viik

A Fusion of Handcrafted Feature-Based and Deep Learning Classifiers for Heart Murmur Detection 5
Zaria Imran, Ethan Grooby, Vinayaka Vivekananda Malgi, Chiranjibi Sitaula, Sunil Aryal, Faezeh Marzbanrad

Robustness of Residual Network in Predicting PR Interval Trained Using Noisy Labels 9
Loc Cao, Hamid Ghanbari, Negar Farzaneh, Kevin R Ward, Sardar Ansari

Exercise-Based Predictors of Late Recurrence of Atrial Fibrillation After Catheter Ablation 13
Jakub Hejc, Richard Redina, Tomas Kulik, Martin Pesl, Zdenek Starek

Murmur Classification with U-Net State Prediction 17
Sanghoon Choi, Hyo-Chang Seo, Choi Kyungmin, Gi-Won Yoon, Segyeong Joo

Automated Algorithm for QRS Detection in Cardiac Arrest Patients with PEA 21
Jon Urteaga, Andoni Elola, Elisabete Aramendi, Anders Norvik, Eirik Unneland, Eirik Skogvoll

Prediction of Deterioration in Critically Ill Patients with Heart Failure Based on Vital Signs Monitoring 25
Shengyu Zhang, Kang Yang, Wenyu Ye, Haoyu Jiang, Xianliang He, Lei Wang, Yijing Li

The Effects of Long- And Short-Term Memory on Action Potential Duration for Atrial Cellular Automata 29
Giada S. Romitti, Pau Romero, Alejandro Liberos, Dolors Serra, Ignacio García-Fernandez, Miguel Lozano, Rafael Sebastian, Miguel Rodrigo

A Validation Study of Two Wrist Worn Wearable Devices for Remote Assessment of Exercise Capacity 33
Alexandra Jamieson, Michele Orini, Nish Chaturvedi, Alun D Hughes

Autonomic Nervous System Recovery After Various Exercises in Highly Trained Athletes 37
Lucie Saclova, Andrea Nemcova, Jiri Sacl, Marina Ronzhina, Radovan Smisek, Lukas Smital, Martin Vitek

Longitudinal Assessment of Fetal Heart Rate Variability During Pregnancy 41
Maretha Bester, Rohan Joshi, Fenna P J A Snellings, Massimo Mischi, Judith O E H Van Laar, Rik Vullings

Murmur Identification Using Supervised Contrastive Learning 45
L'Ubomír Antoni, Erik Bruoth, Peter Bugata, Peter Bugata, Dávid Gajdoš, Dávid Hudák, Vladimíra Kmecová, Monika Stanková, Alexander Szabari, Gabriela Vozáriková

Detecting Intrapartum Fetal Hypoxia from Cardiotocography Using Machine Learning 49
Farah Francis, Honghan Wu, Saturnino Luz, Rosemary Townsend, Sarah Stock

Deep Learning and Permutation Entropy in the Stratification of Patients with Chagas Disease 53
Diego Rodrigo Cornejo, Antonio Ravelo-García, Esteban Alvarez, María Fernanda Rodríguez, Luz Alexandra Díaz, Víctor Cabrera-Caso, Dante Condori-Merma, Miguel Vizcardo Cornejo

Model-Based Analysis of Apnea-Bradycardia Events in Newborns 57
Orlane Duport, Virginie Le Rolle, Gustavo Guerrero, Alain Beuchée, Alfredo Hernández

Approximate Entropy and Densely Connected Neural Network in the Early Diagnostic of Patients with Chagas Disease 61
María Fernanda Rodríguez, Antonio Ravelo-García, Esteban Alvarez, Luz Alexandra Díaz, Diego Rodrigo Cornejo, Victor Cabrera-Caso, Dante Condori-Merma, Miguel Vizcardo Cornejo

Improved Pulse Pressure Estimation Based on Imaging Photoplethysmographic Signals 65
Matthieu Scherpf, Hagen Malberg, Martin Schmidt

Using High-Resolution Voltage Maps to Predict “redo” in the Treatment of Atrial Fibrillation (AF) 69
Jean Bragard, Leire Moriones, Blas Echebarria, Susana Ravassa, Javier Ibero, Ignacio García-Bolao

Classification of Murmurs in PCG Using Combined Frequency Domain and Physician Inspired Features 73
Julia Ding, Jing-Jing Li, Max Xu

Deep Learning Based Heart Murmur Detection Using Frequency-Time Domain Features of Heartbeat Sounds 77
Jungguk Lee, Taein Kang, Narin Kim, Soyul Han, Hyejin Won, Wuming Gong, Il-Youp Kwak

Estimation of F-Wave Dominant Frequency Using a Voting Scheme 81
Shany Biton, Mahmoud Suleiman, Noam Ben Moshe, Leif Sörnmo, Joachim A Behar

Listen2YourHeart: A Self-Supervised Approach for Detecting Murmur in Heart-Beat Sounds 85
Aristotelis Ballas, Vasileios Papapanagiotou, Anastasios Delopoulos, Christos Diou

Transfer Entropy Between RR and QT Intervals in Long QT Syndrome 89
Jiyeong Kim, Matias Kanniainen, Ilya Potapov, Esa Räsänen

Exploring a Segmentation-Classification Deep Learning-Based Heart Murmurs Detector 93
Daniel Enériz, Antonio J Rodríguez-Almeida, Himar Fabelo, Samuel Ortega, Francisco Balea-Fernandez, Nicolás J Medrano, Belén Calvo, Gustavo M Callicó

Computational Study of the Effects of AF-Related Genetic Mutations in 3D Human Atrial Model 97
Rebecca Belletti, Lucia Romero, Javier Saiz

Two-Stage Multitask-Learner for PCG Murmur Location Detection 101
Maurice Rohr, Benedikt Müller, Sebastian Dill, Gökhan Güney, Christoph Hoog Antink

In-Silico Inducibility of Ventricular Tachycardia in Patient-Specific Post-Infarction Ventricular Models 105
Javier Villar, Juan F Gomez, David Soto-Iglesias, Diego Penela, Antonio Berruezo, Beatriz Trenor

Cuff-Less Estimation of Blood Pressure from Vibrational Cardiography Using a Convolutional Neural Network 109
James Skoric, Yannick D'Mello, Nathan Clairmonte, Angus McLean, Siddiqui Hakim, Ezz Aboulezz, Michel Lortie, David V. Plant

Tracking Atrial Fibrillation Mechanisms: A Computational Method for Locating Rotors and Ectopic Activity Using Curl and Divergence Operators 113
Italo Sandoval, John A Sims, João Salinet

AI-Enabled ECG Combined with Dry Electrode Sensors for Population-Based Screening of Atrial Fibrillation 117
Alan Kennedy, Dewar D Finlay, Raymond Bond, Daniel Guldenring, James McLaughlin, Chris Crockford

Coronary Health Index (CHI) as a Determinant for Arterial Stenosis, Derived Using PPG and ECG Signals 121
Poulomi Pal, Manjunatha Mahadevappa

Aerobic Fitness Level Estimation Using Wearables 125
Radovan Smisek, Andrea Nemcova, Lukas Smital, Daniela Chlibkova, Martin Kralik, Jana Kolarova, Vojtech Myska, Martin Kolarik, Michal Harvanek, Jakub Arm, Ondrej Bastan, Martin Pospisil, Jan Sima, Jaromir Hubalek

Heart Murmur Detection from Phonocardiogram Based on Residual Neural Network with Classes Distinguished Focal Loss 129
Pan Xia, Yicheng Yao, Changyu Liu, Hao Zhang, Lirui Xu, Yuqi Wang, Lidong Du, Yusi Zhu, Zhen Fang

Predicting Daytime Sleepiness from Electrocardiography Based Respiratory Rate Using Deep Learning 133
Emmi Antikainen, Rana Zia Ur Rehman, Teemu Ahmaniemi, Meenakshi Chatterjee

Can Sequentially Collected Electrograms Be Effectively Used for Dominant Frequency Mapping During Persistent AF? 137
Xin Li, Charlie Hugill, Gavin S Chu, Mahmoud Ehnesh, Tiago P Almeida, Bharat Sidhu, Ibrahim Antoun, Ahmed Kotb, Peter J Stafford, G André Ng, Fernando S Schlindwein

Lirot.ai: A Novel Platform for Crowd-Sourcing Retinal Image Segmentations 141
Jonathan Fhima, Jan Van Eijgen, Moti Freiman, Ingeborg Stalmans, Joachim A Behar

A Simulation Study on the Effect of Antiarrhythmic Drugs During Myocardial Infarction 145
Cuiping Liang, Zhiyang He, Cunjin Luo, Qince Li, Jun Liu, Suiping Jiang

Equivalent Dipole Trajectories Assessed from the 12-Lead ECG Using a Tailored Human Torso Model 149
Vito Starc

Generalization Capability of a Neural Network for Blood Pressure Estimation from Photoplethysmography 153
Clémentine Aguet, Jérôme Van Zaen, Martin Proença, Guillaume Bonnier, Pascal Frossard, Mathieu Lemay

Machine Learning-Based Classification of Ischemic and Non-Ischemic Exercise Stress Test ECG 157
Dibya Chowdhury, Bala Chakravarthy Neelapu, Kunal Pal, J Sivaraman

Naive Bayesian-Based Nomogram for Identification of Early Asymptomatic Dilated Cardiomyopathy 161
Aleksandar Miladinovic, Katerina Iscra, Miloš Ajcevic, Luca Restivo, Simone Kresevic, Marco Merlo, Gianfranco Sinagra, Agostino Accardo

Chest-Lead Generation with Single-Lead 165
Gi-Won Yoon, Hyo-Chang Seo, Choi Kyungmin, Kim Hannah, Segyeong Joo

ArNet-ECG: Deep Learning for the Detection of Atrial Fibrillation from the Raw Electrocardiogram 169
Noam Ben-Moshe, Shany Biton, Joachim A Behar

Arrhythmia Detection Using Spiking Variable Projection Neural Networks 173
Péter Kovács, Kaveh Samiee

Numerical Simulations Indicate I_{K1} Dynamic Clamp Can Unveil the Phenotype of Cardiomyocytes Derived from Induced Pluripotent Stem Cells..... 177
Sofia Botti, Chiara Bartolucci, Claudia Altomare, Lucio Barile, Rolf Krause, Luca F Pavarino, Stefano Severi

Transfer Function Gain Between Heart Period and QT Interval Variability Decreases at a 10-Year Follow-Up in Half-Marathon Runners 181
Beatrice De Maria, Vlasta Bari, Beatrice Cairo, Francesca Gelpi, Daniela Lucini, Massimo Pagani, Mara Malacarne, Aparecida Maria Catai, Mariana De Oliveira Gois, Francesca Perego, Laura Adelaide Dalla Vecchia, Alberto Porta

Feature Contributions to ECG-Based Heart-Failure Detection: Deep Learning Vs. Statistical Analysis..... 185
Agnese Sbrollini, Chiara Leoni, Marjolein C De Jongh, Micaela Morettini, Laura Burattini, Cees A Swenne

Modified Variable Kernel Length ResNets for Heart Murmur Detection and Clinical Outcome Prediction Using Phonocardiogram Recordings..... 189
Vijay Vignesh Venkataramani, Akshit Garg, U Deva Priyakumar

Comparison Between ECG-Derived Respiration and Respiratory Flow for the Assessment of Cardiorespiratory Coupling Before and After Cardiopulmonary Exercise Test Protocol..... 193
Beatrice Cairo, Vlasta Bari, Francesca Gelpi, Beatrice De Maria, Anita Mollo, Francesco Bandera, Alberto Porta

Automatic Identification of the Best Auscultation Area for the Estimation of the Time of Closure of Heart Valves Through Multi-Source Phonocardiography..... 197
Noemi Giordano, Gabriella Balestra, Marco Ghislieri, Marco Knaflitz, Samanta Rosati

Comparison of Signal Combinations for Cardiorespiratory Sleep Staging 201
Miriam Goldammer, Sebastian Zaunseder, Franz Ehrlich, Hagen Malberg

Maiby's Algorithm: A Two-Stage Deep Learning Approach for Murmur Detection in Mel Spectrograms for Automatic Auscultation of Congenital Heart Disease..... 205
Matheus Araujo, Dewen Zeng, Joao Palotti, Xirong Xi, Yiyu Shi, Lee Pyles, Quan Ni

Effect of Segmentation Uncertainty on the ECGI Inverse Problem Solution and Source Localization..... 209
Narimane Gassa, Machteld Boonstra, Beata Ondrusoval, Jana Svehlikova, Dana Brooks, Akil Narayan, Ali Salman Rababah, Peter Van Dam, Rob Macleod, Jess Tate, Nejib Zemzemi

A Patient-Specific Single Equivalent Dipole Model 213
Gabriel Cardoso, Geneviève Robin, Andony Arrieula, Mark Potse, Michel Haïssaguerre, Eric Moulines, Rémi Dubois

Recovery Assessment of Open-Heart Cardiac Surgery Patients Using Heart Rate Variability Parameters 217
Seyedsadra Miri, Sabina Lähteenmäki, Lassi Tuomisto, Heidi Mahrberg, Antti Vehkaoja, Jari Laurikka, Jari Viik

Using Computational Modelling to Define the Ideal Characteristics of Antiarrhythmic Drugs in Acute Ischemia..... 221
Ander Loidi, José M Ferrero

Frequency Domain Causal Analysis Allows the Detection of Baroreflex Control Recovery in Patients Undergoing Surgical Aortic Valve Replacement After a Three-Months Follow-Up 225
Vlasta Bari, Francesca Gelpi, Beatrice Cairo, Noemi Cornara, Beatrice De Maria, Marco Ranucci, Alberto Porta

A Computational Model of Brugada Syndrome in 3D Heterogeneous Cardiac Tissue 229
Paolo Seghetti, Niccolò Biasi, Marco Laurino, Alessandro Tognetti

Prediction of Delivery Mode from Fetal Heart Rate and Electronic Medical Records Using Machine Learning 233
Xue Kang, Rongdan Zeng, Hao Yi, Chuan Wang, Mujun Liu, Zheng Zheng, Yaosheng Lu, Huijin Wang, Jieyun Bai

In Silico Evaluation of New Approaches in Cardiac Resynchronization Therapy 237
Cristóbal R Ruiz, Juan F Gómez, Eduardo Castellanos, Jesús Almendral, Beatriz Trenor

Detection of Short Supraventricular Tachycardias in Single-Lead ECGs Recorded Using a Handheld Device 241
Hesam Halvaei, Tove Hygrell, Emma Svennberg, Valentina Da Corino, Leif Sörnmo, Martin Stridh

Influence of Gestational Diabetes on Fetal Heart Rate in Antepartum Cardiotocographic Recordings 245
Giulio Steyde, Beniamino Daniele, Edoardo Spairani, Giovanni Magenes, Maria Gabriella Signorini

Multimodal Analysis of Physiological Signals for Wearable-Based Emotion Recognition Using Machine Learning 249
Feryal A Alskafi, Ahsan H Khandoker, Uichin Lee, Cheul Young Park, Herbert F Jelinek

AI Based Directory Discovery Attack and Prevention of the Medical Systems 253
Ying He, Cunjin Luo, Jiyuan Zheng, Kuanquan Wang, Henggui Zhang

Novel Method for Orientation-Independent Analysis in Equi-Spaced Multi-Electrode Arrays 257
Izan Segarra, Samuel Ruipérez-Campillo, Francisco Castells, José Millet

Extraction Algorithm for Morphologically Preserved Non-Invasive Multi-Channel Fetal ECG 261
Giulia Baldazzi, Danilo Pani, Hau-Tieng Wu

End-To-End Deep Learning and Sensor Fusion for Non-Invasive BP Monitoring Using Multivariate Physiological Signals 265
Pietro Cerveri, Mattia Sarti, Matteo Rossi, Giulia Alessandrelli, Carolina Lombardi, Luca Mainardi

A Lightweight Robust Approach for Automatic Heart Murmurs and Clinical Outcomes Classification from Phonocardiogram Recordings 269
Hui Lu, Julia Beatriz Yip, Tobias Steigleder, Stefan Grießhammer, Maria Heckel, Naga Venkata Sai Jitin Jami, Bjoern Eskofier, Christoph Ostgathe, Alexander Koelpin

Reproducibility of Machine Learning Models for Paroxysmal Atrial Fibrillation Onset Prediction 273
Cédric Gilon, Jean-Marie Grégoire, Jérome Hellinckx, Stéphane Carlier, Hugues Bersini

On the Initial Estimate of Repolarization Times for Inverse Reconstruction Using the Equivalent Dipole Layer Source Model 277
Jeanne Van Der Waal, Veronique Meijborg, Machteld Boonstra, Thom Oostendorp, Ruben Coronel

The P-Wave Time-Domain Significant Features to Evaluate Substrate Modification After Catheter Ablation of Paroxysmal Atrial Fibrillation 281
Aikaterini Vraka, Vicente Bertomeu-González, Leif Sörnmo, Roberto Zangróniz, Raúl Alcaraz, José J Rieta

Fetal Heart Sound Split Detection and Classification in Phonocardiographic Signals 285
Kristóf Müller, Bálint Áron Üveges, Márton Áron Goda

A New Filtering Method for Smoothing Intracardiac Records Preserving the Steepness of A, V, H Waves 289
Oto Janousek, Jakub Hejc, David Pospisil

Automated Musical Rhythm Transcription of ECG RR Interval Time Series as a Tool for Representing Rhythm Variations and Annotation Anomalies in Arrhythmia Heartbeat Classifications 293
Gonzalo Romero-García, Paul Lascabettes, Elaine Chew

Densely Connected Neural Network and Permutation Entropy in the Early Diagnostic in COVID Patients 297
Luz Alexandra Díaz, Antonio Ravelo-García, Esteban Alvarez, María Fernanda Rodríguez, Diego Rodrigo Cornejo, Victor Cabrera-Caso, Dante Condori-Merma, Miguel Vizcardo Cornejo

The Effect of Heart Rate and Atrial Contraction on Left Ventricular Function 301
Rosie K Barrows, Marina Strocchi, Christoph M Augustin, Matthias A F Gsell, Caroline H Roney, Jose A Solis-Lemus, Hao Xu, Karli K Gillette, Ronak Rajani, John Whitaker, Edward J Vigmond, Martin J Bishop, Gernot Plank, Steven A Niederer

An Extension of Quadratic Variation Regularization for Simultaneous Baseline Wander and Power Line Interference Removal from ECG 305
Arman Kheirati Roonizi, Roberto Sassi

Employing Support Vector Machine Regression to Estimate the Fetal Gestational Age 309
Maisam Wahbah, Raghad Al Sakaji, Kiyoe Funamoto, Anita Krishnan, Yoshiyuki Kasahara, Yoshitaka Kimura, Ahsan H. Khandoker

Raising High-Risk Awareness in Hemodynamic Treatment with Reinforcement Learning for Septic Shock Patients 313
Meicheng Yang, Runfa Li, Tong Hao, Caiyun Ma, Jianqing Li, Chengyu Liu

Assessment of Transcatheter Heart Valve Migration and Embolization Risk Following Valve-In-MAC 317
Samuel J Hill, Alistair Young, Ronak Rajani, Adelaide De Vecchi

Machine Learning Based Cell Model for Fast Approximation of Cellular Action Potential to Enable Clinical Translation 321
Pau Romero, Miguel Lozano, Giada Romitti, Dolors Serra, Ignacio Garcia-Fernandez, Alejandro Liberos, Miguel Rodrigo, Rafael Sebastian

Rotors Drift Toward and Stabilize in Low Power Regions in Heterogeneous Models of Atrial Fibrillation 325
Laura Martinez-Mateu, Javier Saiz, Omer Berenfeld

A Comparison of Multithreading, Vectorization, and GPU Computing for the Acceleration of Cardiac Electrophysiology Models 329
Chiheb Sakka, Amina Guermouche, Olivier Aumage, Emmanuelle Saillard, Mark Potse, Yves Coudière, Denis Barthou

Comparing the Efficacy of Electrocardiographic Leads in Recovery Phase in Detecting Coronary Artery Disease in Women 333
Serkalem D Beyene, Kjell C Nikus, Terho J Lehtimäki, Mika Ap Kähönen, Jari J Viik

Cardiac Time Intervals Derived from Electrocardiography and Seismocardiography in Different Patient Groups 337
Ismail Elnaggar, Jouni Pykäri, Tero Hurnanen, Olli Lahdenoja, Antti Airola, Matti Kaisti, Tuija Vasankari, Mikko Savontaus, Tero Koivisto

Multichannel Bed Based Ballistocardiography Heart Rate Estimation Using Continuous Wavelet Transforms and Autocorrelation 341
Ismail Elnaggar, Tero Hurnanen, Jonas Sandelin, Olli Lahdenoja, Antti Airola, Matti Kaisti, Tero Koivisto

Does Ectopic Beats Bring More Discriminatory Information to Diagnose Ischemic Heart Disease? 345
Katerina Iscra, Aleksandar Miladinovic, Miloš Ajcevic, Luca Restivo, Simone Kresevic, Marco Merlo, Gianfranco Sinagra, Agostino Accardo

Heart Murmur Detection of PCG Using ResNet with Selective Kernel Convolution 349
Yonghao Gao, Lihong Qiao, Zhixiang Li

Inter-Individual Differences in Cell Composition Across the Ventricular Wall May Explain Variability in ECG Response to Serum Potassium and Calcium Variations 353
Hassaan A Bukhari, Carlos Sánchez, Pablo Laguna, Mark Potse, Esther Pueyo

Left Pulmonary Veins Isolation: The Cornerstone in Noninvasive Evaluation of Substrate Modification After Catheter Ablation of Paroxysmal Atrial Fibrillation 357
Aikaterini Vraka, José Moreno-Arribas, Juan M. Gracia-Baena, Flavia Ravelli, Raúl Alcaraz, José J Rieta

Relationship Between ECG-Pattern of Depolarization Abnormalities and an Mildly Reduced Ejection Fraction 361
Maria Gordeeva, Irina Serdiukova, Alexander Krasichkov, Elena Parmon

A Machine Learning Approach to Predict Arterial Blood Pressure from Photoplethysmography Signal 363
Felipe M Dias, Thiago B S Costa, Diego A C Cardenas, Marcelo A F Toledo, Jose E Krieger, Marco A Gutierrez

Evaluation of a Combined Approach for Denoising ECG Measurements Using Unconventional Sensors 367
Henry Dore, Rodrigo Aviles-Espinosa, Elizabeth Rendon-Morales

Listening Effort: Cardiovascular Investigation Through the Point Process 371
Edoardo Maria Polo, Maximiliano Mollura, Alessia Paglialonga, Riccardo Barbieri

Validation of a Novel Imageless Non-Invasive Electrocardiographic Imaging for the Characterization of Atrial Tachycardias 375
J Reventos-Presmanes, E Invers-Rubio, E Ferró, I Hernández-Romero, Clara Herrero-Martín, J Milagro, D Lundback, E Guasch, Jm Tolosana, I Roca-Luque, MS Guillem, L Mont, Jb Guichard, Am Climent

Machine Learning of Drug Influence Based on iPSC Cardiomyocyte Calcium Transient Signals 379
Martti Juhola, Henry Joutsijoki, Risto-Pekka Pölönen, Katriina Aalto-Setälä

Arrhythmia Detection Based on Semantic Segmentation for Multi-Lead ECG 382
Hanshuang Xie, Mengna Zheng, Huaiyu Zhu, Fan Wu, Yun Pan

Beat-Wise Uncertainty Learning for Murmur Detection in Heart Sounds 386
Xingyao Wang, Foli Fan, Hongxiang Gao, Shuo Zhang, Chenxi Yang, Jianqing Li, Chengyu Liu

Label-Free Estimation of Sarcomere Orientation from Brightfield Microscopy Images of Induced Pluripotent Stem Cell Derived Cardiomyocyte Nuclei 390
Antti Ahola, Birhanu Belay, Carolina Wählby, Jari Hyttinen

Influence of the Training Set Size on the Subject-To-Subject Variability of the Estimation Performance of Linear ECG-Lead Transformations 394
Daniel Guldenring, Ali Rababah, Dewar D Finlay, Raymond R Bond, Alan Kennedy, Peter Doggart, James McLaughlin

A Sliding Window Approach to Regularization in Electrocardiographic Imaging 398
Benjamin A Orkild, Jake A Bergquist, Lindsay C Rupp, Anna Busatto, Brian Zenger, Wilson W Good, Jaume Coll-Font, Rob S Macleod

Feasibility of Wearable Armband Bipolar ECG Lead-1 for Long-Term HRV Monitoring by Combined Signal Averaging and 2-Stage Wavelet Denoising 402
Omar J Escalona, Sophie Magwood, Anna Hilton, Niamh McCallan

Classification of Atrial Tachycardia Types Using Dimensional Transforms of ECG Signals and Machine Learning 406
Samuel Ruipérez-Campillo, José Millet, Francisco Castells

Unipolar R:S Development in Chronic Atrial Fibrillation 410
Eric Paccione, Bram Hunt, Eugene Kwan, Derek Dosdall, Rob Macleod, Ravi Ranjan

Physics-Informed Fully Connected and Recurrent Neural Networks for Cardiac Electrophysiology Modelling 414
Iulia Nazarov, Ihsane Olakorede, Ahmed Qureshi, Shaheim Ogbomo-Harmitt, Oleg Aslanidi

In Silico Assessment of a Multipore Electrode Design for High Power Short Duration Ablation 418
Argyrios Petras, Massimiliano Leoni, Zoraida Moreno Weidmann, Jose M Guerra, Luca Gerardo-Giorda

Non-Invasive Atrial Fibrillation Driver Localization Using Recurrent Neural Networks and Body Surface Potentials 422
Miriam Gutiérrez-Fernández-Calvillo, Miguel Ángel Cámara-Vázquez, Ismael Hernández-Romero, María S Guillem, Andreu M Climent, Óscar Barquero-Pérez

Description of the Volume-Clamp Method of Blood Pressure Measurements Using the Mathematical Model of the Lamé Problem 426
Marek Zylinski, Wiktor Niewiadomski, Gerard Cybulski, Anna Gasiorowska

Uncoupling Between Heart Rate Variability and Heart Rate During Exercise and Recovery as a Predictor of Cardiovascular Events 430
Michele Orini, S Van Duijvenboden, J Ramírez, A Tinker, Pb Munroe, Pd Lambiase

ACQuA: Anomaly Classification with Quasi-Attractors 434
William Rudman, Jack Merullo, Laura Mercurio, Carsten Eickhoff

Verification of the Assumptions of Volume-Clamp Method for Continuous Blood Pressure Measurement in a Silicone Phantom 438
Marek Zylinski, Gerard Cybulski

Impact of Noise on Electrocardiographic Imaging Resolution with Zero Order Tikhonov Regularization and L-Curve Optimization 442
Rubén Molero, Jana Reventós-Presmanes, Ivo Roca, Lluís Mont, Andreu M Climent, María S Guillem

An in Silico Investigation into the Role of SK Channels in Failing Ventricular Myocytes 446
Marta Gomez, Jesus Carro, Esther Pueyo, Violeta Monasterio

Probabilistic Inference of Comorbidities from Symptoms in Patients with Atrial Fibrillation: An Ontology-Driven Hybrid Clinical Decision Support System 450
Alexander Lacki, Diego Bosca, Antonio Martinez-Millana

Estimation of the Atrial Activity from Electrograms: A Beamforming Perspective 454
Tijs Moree, Mathijs S Van Schie, Natasja Ms De Groot, Richard C Hendriks

Optimal Fluid and Vasopressor Interventions in Septic ICU Patients Through Reinforcement Learning Model 458
Maximiliano Mollura, Cristian Drudi, Li-Wei Lehman, Riccardo Barbieri

Computer Simulations of Composite Maps for Detection of Atrial Fibrillation Mechanisms 462
Ozan Özgül, Victor G. Marques, Ben Hermans, Arne Van Hunnik, Sander Verheule, Ulrich Schotten, Ali Gharaviri, Simone Pezzuto, Angelo Auricchio, Pietro Bonizzi, Stef Zeemering

Heart Position Uncertainty Quantification in the Inverse Problem of ECGI 466
Jake A Bergquist, Lindsay C Rupp, Anna Busatto, Ben Orkild, Brian Zenger, Wilson Good, Jaume Coll-Font, Akil Narayan, Jess Tate, Dana Brooks, Rob S Macleod

Shear Wave Imaging Framework for Quantification of Myocardial Tissue Properties 470
Martin S Andersen, Peter Søgaard, Samuel E Schmidt, Johannes J Struijk

Characterization of Autonomic Dysfunction in REM Sleep Behavior Disorder 474
Nicla Mandas, Maximiliano Mollura, Giulia Baldazzi, Michela Figorilli, Monica Puligheddu, Danilo Pani, Riccardo Barbieri

Probabilistic Dominant Frequency Estimation in AF from ECGI 478
C Fambuena-Santos, I Hernández-Romero, C Herrero-Martín, J Reventós-Presmanes, E Invers-Rubio, L. Mont, Am Climent, MS Guillem

Improved Non-Contact Heart Chamber Modeling Using Catheter Mediated Ultrasound Returns 482
Derrick Chou, Jaume Coll-Font, Lea Melki, Wilson W Good, Steve Yon

Controllability of Voltage- And Calcium-Driven Alternans in a Cardiac Ionic Model 486
Laura M Muñoz, Mark O Ampofo, Elizabeth M Cherry

Sport?Sicuro! A Graphical User Interface for Continuous Cardiovascular Monitoring While Playing Sport Based on Heart Rate and Heart-Rate Variability 490
Sofia Romagnoli, Agnese Sbrollini, Ilaria Marcantoni, Micaela Morettini, Laura Burattini

Modeling Structural Abnormalities in Equivalent Dipole Layer Based ECG Simulations 494
Manon Kloosterman, Machteld J Boonstra, Folkert W Asselbergs, Peter Loh, Thom F Oostendorp, Peter M Van Dam

Tracking of Atrial Fibrillation Drivers Based on Propagation Patterns: An In-Silico Study 498
Victor G Marques, Ali Gharaviri, Simone Pezzuto, Angelo Auricchio, Pietro Bonizzi, Stef Zeemering, Ulrich Schotten

Comparison of Heart Rate Variability Indices Based on Seismocardiograms from Healthy Volunteers and Patients with Valvular Heart Diseases 502
Szymon Siecinski, Pawel S Kostka, Ewaryst J Tkacz

The Role of Beta-1 Receptors in the Response to Myocardial Ischemia 506
Lindsay C Rupp, Brian Zenger, Jake A Bergquist, Anna Busatto, Rob S Macleod

Mutation-Specific Hypertrophic Cardiomyopathy and Mavacamten: A Mechano-Energetic in Silico Study 510
Mohamadamin Forouzandehmehr, Michelangelo Paci, Jussi T Koivumäki, Jari Hyttinen

A Method for Incorporating Changes in Extracellular Volume and Myocyte Size into the Cardiac Bidomain Equations 514
Vladimír Sobota, Sarah Nordmeyer, Christoph Augustin, Gernot Plank, Edward J Vigmond, Jason D Bayer

Unexpected Errors in the Electrocardiographic Forward Problem 518
Anna Busatto, Jake A Bergquist, Lindsay C Rupp, Brian Zenger, Rob S Macleod

Classification of Phonocardiograms Using Residual Convolutional Neural Network and MLP 522
Guohui Peng, Haitao Zou, Jin Wang

Analysis of Atrial Fibrillation Dynamics in Body Surface Potential Maps and Electrocardiographic Imaging 526
Rubén Molero, Olivier Meste, Joël Karel, Ralf Peeters, Pietro Bonizzi, María S Guillem

Updates on OpenEP: The Open-Source Platform for Electrophysiological Data Analysis 530
Steven E Williams, Paul Smith, Ali Gharaviri, Christopher O'Shea, Adam Connolly, Louisa O'Neill, Irum Kotadia, Iain Sim, Neil Bodagh, Neil Grubb, John Whitaker, Matthew Wright, Steven Niederer, Mark O'Neill, Martin Bishop, Nick Linton

Cell Unexcitability and Electrotonic Coupling Phenomenon Analysis of Ablation-Created Lesions: A Study Case with Ablated Explanted Human Heart 534
J Siles, J Salinet, CJ Crowley, F Fenton, N Bhatia, S Iravanian, I Uzelac

Hierarchical Multi-Scale Convolutional Network for Murmurs Detection on PCG Signals 538
Yujia Xu, Xinqi Bao, Hak-Keung Lam, Ernest N. Kamavuako

Accelerating Stabilization of Whole-Heart Models After Changes in Cycle Length 542
Hassaan A Bukhari, Carlos Sánchez, Esther Pueyo, Mark Potse

Simulation of Acquired LQT Syndrome Using Human Virtual Ventricular Cardiomyocyte Model 546
Shumo Zhao, Cunjin Luo, Ying He, Linghua Li

Tailoring Process for the Regional Personalization of Atrial Fibrillation with a Novel Cardiac Model 550
Clara Herrero-Martin, C. Fambuena-Santos, María S Guillem, Andreu M Climent, Ismael Hernández-Romero

Local Conduction Velocity Estimation During Wavefront Collisions and Reentrant Scenarios 554
Ismael Hernández-Romero, C. Fambuena-Santos, Clara Herrero-Martin, Andreu M Climent, María S Guillem

Phonocardiographic Murmur Detection by Scattering-Recurrent Networks 558
Philip A Warrick, Jonathan Afilalo

Effect of Torso Mesh Density on Electrocardiographic Imaging Resolution from Atrial Fibrillation Simulations 562
Rubén Molero, Ana González-Ascaso, Ismael Hernández-Romero, Andreu M Climent, María S Guillem

Multitask and Transfer Learning for Cardiac Abnormality Detections in Heart Sounds 566
João L Costa, Paula Couto, Rui Rodrigues

Heart Murmur Detection and Clinical Outcome Prediction Using Multilayer Perceptron Classifier 570
Kiarash Jalali, Mohammad Amin Saket, Saman Noorzadeh

Modeling of the Effect of Alcohol on Episode Patterns in Atrial Fibrillation 574
Vilma Plušciauskaite, Andrius Rapalis, Monika Butkuviene, Vaidotas Marozas, Leif Sörnmo, Andrius Petrenas

Ventricular Conduction System Modeling for Electrophysiological Simulation of the Porcine Heart 578
Ricardo M Rosales, Konstantinos A Mountris, Manuel Doblaré, Manuel M Mazo, Esther Pueyo

Sensitivity Analysis of Electrocardiogram Features to Computational Model Input Parameters 582
Jenny Venton, Karli Gillette, Matthias Gsell, Axel Loewe, Claudia Nagel, Benjamin Winkler, Louise Wright

Movement, Sweating, and Contact Pressure as Sources of Heart Rate Inaccuracy in Wearable Devices 586
Michele Orini, Gabrielle Guvensen, Alexandra Jamieson, Nish Chaturvedi, Alun D Hughes

Association Between Photoplethysmography Pulse Upslope and Cardiovascular Events in Over 170,000 UK Biobank Participants 590
Michele Orini, S Van Duijvenboden, A Tinker, Pb Munroe, Pd Lambiase

Electrogram-Based Estimation of Myocardial Conduction Using Deep Neural Networks 594
Konstantinos Ntagiantas, Dimitrios Panagopoulos, Wing M Poon, Jothi L Mahendra Kumar, Danya Agha-Jaffar, Nicholas S Peters, Chris D Cantwell, Anil A Bharat, Rasheda A Chowdhury

Toward a Quasi-Dynamic Pulsed Field Electroporation Numerical Model for Cardiac Ablation: Predicting Tissue Conductance Changes and Ablation Lesion Patterns 598
Richard Simon, Nishaki K Mehta, Kuldeep B Shah, David E Haines, Cristian A Linte

Use of Recurrent Neural Networks for Mean Blood Pressure Prediction Based on Impedance Cardiography Measurements 602
Marek Zylinski, Wiktor Niewiadomski, Gerard Cybulski

Adaptive Electrocardiogram Enhancement in Strong Noise Environment 605
Qian Li, Xingyao Wang, Chenxi Yang, Jianqing Li, Chengyu Liu

An LSTM-Based Listener for Early Detection of Heart Disease 609
Philip Gemke, Nicolai Spicher, Tim Kacprowski

Far-Field Intracardiac Electrograms Removal Enables Highly Reliable Automatic Cycle Length Estimation During Atrial Arrhythmia 613
Thomas Boudou, Julien Seitz, Clément Bars

Automated Detection of Ventricular Heartbeats from Electrocardiogram (ECG) Acquired During Magnetic Resonance Imaging (MRI) 617
Pierre G Aublin, Jacques Felblinger, Julien Oster

Harnessing Dermal Blood Flow to Mitigate Skin Heating Effects in Wireless Transdermal Energy Systems for Driving Heart Pumps 621
Mohammad L Karim, Antonio Bosnjak, James McLaughlin, Paul Crawford, David McEneaney, Omar J Escalona

Variability of Premature Ventricular Contraction Localization with Respect to Source and Forward Model Variation in Clinical Data 625
Nika Rasoolzadeh, Jana Svehlikova, Beata Ondrusova, Yesim Serinagaoglu Dogrusoz

In Vivo Analysis of Conduction Pattern Dynamics: System Development and Application Using OpenEP 629
Ali Gharaviri, Louisa O'Neill, Paul Smith, Caroline H Roney, Neil Grubb, Matthew Wright, Mark O'Neill, Steven E Williams

Detection of Arterial Hypertension Through Electrocardiograms 633
Eduardo D Mio, Larissa A F Vieira, Derick M Oliveira, Antonio L Ribeiro, Wagner Meira

Modelling and Simulation Reveals Density-Dependent Re-Entry Risk in the Infarcted Ventricles After Stem Cell-Derived Cardiomyocyte Delivery 637
Leto L Riebel, Zhinuo J Wang, Hector Martinez-Navarro, Cristian Trovato, Jacopo Biasetti, Rafael Sachetto Oliveira, Rodrigo Weber Dos Santos, Blanca Rodriguez

Efficacy of Spectral Signatures for the Automatic Classification of Abnormal Ventricular Potentials in Substrate-Guided Mapping Procedures 641
Giulia Baldazzi, Marco Orrù, Mirko Matraxia, Graziana Viola, Danilo Pani

Patient Phenotyping Using Interpretable Clustering to Study Clinical Outcomes in TAVR Patients 645
Roy S. Zawadzki, Terri Johnson, Saman Parvaneh

ECG Analysis to Study Social Connections in Older Cardiac Patients 649
María Luz Cardo, Alejandra Chuliàn, Samuel Ruipérez-Campillo, José Millet, Francisco Castells, Raquel Cervigón

A Movement-Artefact-Free Heart-Rate Prediction System 653
Maarten Thoonen, Peter Veltink, Frank Halfwerk, Robby Van Delden, Ying Wang

Detecting Atrial Fibrillation with a Wearable Device 657
Jonas Sandelin, Jukka-Pekka Sirkiä, Arman Anzanpour, Tero Koivisto

Detection of Heart Sound Murmurs and Clinical Outcome with Bidirectional Long Short-Term Memory Networks 661
Sofia Monteiro, Ana Fred, Hugo Plácido Da Silva

Quantifying the Autonomic Nervous System Influence on Heart Rate Turbulence Using Partial Least Squares Path Modeling 665
H Puente-Díaz, R García-Carretero, R Goya-Esteban, O Barquero-Pérez

Omecamtiv Mecarbil Improves Contraction Behaviour in a 3D Electromechanical Tissue Model of Heart Failure 669
Ilsbeth Van Herck, Maria Teresa Mora, Jordi Llopis-Lorente, Henrik Finsberg, Cécile Daversin-Catty, Javier Saiz, Beatriz Trenor, Hermenegild Arevalo, Samuel Wall

Effects of Beta-Blocker on Heart Rate Variability in Heart Failure with Preserved Ejection Fraction 673
Shiza Saleem, Mohanad Alkhodari, Leontios J Hadjileontiadis, Ahsan H Khandoker, Herbert F Jelinek

Remote Monitoring of COVID-19 Patients Following Discharge from a Tertiary Care Center 677
Ganesh Raam Kumarasamy, Hélène De Cannière, Julie Vranken, David Ruttens, Peter Karsmakers, Pieter Vandervoort

Non-Contact Measurement of Respiration Rate with Camera-Based Photoplethysmography During Rest and Mental Stress 681
Hannes Ernst, Hagen Malberg, Martin Schmidt

Impact of Fibrosis Border Zone Characterisation on Fibrosis-Substrate Isolation Ablation Outcome for Atrial Fibrillation 685
Shaheim Ogbomo-Harmitt, Ahmed Qureshi, Andrew King, Oleg Aslanidi

Ultra-High Frequency ECG Deep-Learning Beat Detector Delivering QRS Onsets and Offsets 689
Zuzana Koscova, Radovan Smíšek, Petr Nejedly, Josef Halamek, Pavel Jurak, Pavel Leinveber, Karol Curila, Filip Plesinger

Using Mel-Spectrograms and 2D-CNNs to Detect Murmurs in Variable Length Phonocardiograms..... 693
Marius S Knorr, Jan P Bremer

Drug Dependent Circadian Variations in AV-Nodal Properties During Atrial Fibrillation 697
Mattias Karlsson, Mikael Wallman, Pyotr G Platonov, Sara R. Ulimoen, Frida Sandberg

Intracardiac Electrical Imaging Using the 12-Lead ECG: A Machine Learning Approach Using Synthetic Data 701
Mikel Landajuela, Rushil Anirudh, Joe Loscazo, Robert Blake

Identification of Myocardial Infarction by High Frequency Serial ECG Measurement..... 705
Jonas Sandelin, Tero Koivisto, Jukka-Pekka Sirkiä, Arman Anzanpour

Deep Learning for Ventricular Arrhythmia Prediction Using Fibrosis Segmentations on Cardiac MRI Data..... 709
Florence E Van Lieshout, Roel C Klein, Maarten Z Kolk, Kylian Van Geijtenbeek, Romy Vos, Samuel Ruiperez-Campillo, Ruibin Feng, Brototo Deb, Prasanth Ganesan, Reinoud Knops, Ivana Isgum, Sanjiv Narayan, Erik Bekkers, Bob Vos, Fleur VY Tjong

Modelling Virchow's Triad to Improve Stroke Risk Assessment in Atrial Fibrillation Patients..... 713
Ahmed Qureshi, Maximilian Balmus, Steven E Williams, Gregory Y H Lip, David A Nordsletten, Oleg Aslanidi, Adelaide De Vecchi

Assessing Intrapartum Risk of Hypoxic Ischemic Encephalopathy Using Fetal Heart Rate with Long Short-Term Memory Networks 717
Derek Kweku Degbedzui, Michael Kuzniewicz, Cornet Marie-Coralie, Yvonne Wu, Heather Forquer, Lawrence Gerstley, Emily Hamilton, Doina Precup, Philip Warrick, Robert Kearney

A New Computer-Aided Solution for the Automatic Detection of Metal Stent Struts in Follow-Up Evaluation in OCT Images 721
Zofia Schneider, Elzbieta Pociask, Klaudia Proniewska, Radek Kolecki

Time-Warping Based End-Of-T-Wave Shape Marker Reflects Repolarization Changes During Ischemia 725
Neurys Gómez, Julia Ramírez, Juan Pablo Martínez, Pablo Laguna

Blood Pressure Classification by Analyzing the Behavior of Heart Rate Variability in Poincare Plot..... 729
Shahab Rezaei, Keivan Maghooli, Nader Jafarnia Dabanloo, Fardad Farrokhi, Saman Parvaneh

Impact of Mechanically-Induced Fibrosis on Atrial Electromechanical Function 733
Teresa Schiatti, Marilu Casini, Thomas Hutschalik, Manuel Koch, Ramona Emig, Rémi Peyronnet, Ursula Ravens

Right Ventricular Vs Left Bundle Branch Pacing-Induced Changes in ECG Depolarization and Repolarization 736
Clara Sales, Saúl Palacios, Jorge Melero, Inés Julián, Javier Ramos, Juan Pablo Martínez, Ana Mincholé, Esther Pueyo

A Novel Human Atrial Electromechanical Cardiomyocyte Model with Mechano-Calcium Feedback Effect 740
Fazeelat Mazhar, Francesco Regazzoni, Chiara Bartolucci, Cristiana Corsi, Luca Dedé, Alfio Quarteroni, Stefano Severi

Transformer Embedded with Learnable Filters for Heart Murmur Detection 744
Pengfei Fan, Yucheng Shu, Yiming Han

Cycle Length Estimation Using Accurate Adaptive Detection of Local Activations in Atrial Intracardiac Electrograms 748
Dinara Veshchezerova, Clement Bars, Julien Seitz

Towards an Automated Pipeline to Create Patient Specific 3D LV Geometry Models of Patients with Mitral Annular Disjunction 752
Gabriel Balaban, Eivind Westrum Aabel, Margareth Ribe, Anna Isotta Castrini, Kristina Haugaa, Mary M Maleckar

Initial Reference Values of Electrocardiographic Alternans by Enhanced Adaptive Matched Filter 756
Ilaria Marcantoni, Erica Iammarino, Agnese Sbrollini, Micaela Morettini, Laura Burattini

A Lightweight Unidimensional Deep Learning Model for Atrial Fibrillation Detection 760
Quenaz B Soares, Rosangela Monteiro, Fábio B Jatene, Marco A Gutierrez

Towards Uncertainty-Aware Murmur Detection in Heart Sounds Via Tandem Learning 764
Erika Bondareva, Tong Xia, Jing Han, Cecilia Mascolo

Inference of Number and Location of Purkinje Root Nodes and Ventricular Conduction Properties from Clinical 12-Lead ECGs for Cardiac Digital Twinning 768
Julia Camps, Zhinuo Jenny Wang, Rafael Sebastian, Xin Zhou, Brodie Lawson, Lucas Arantes Berg, Kevin Burrage, Vicente Grau, Rodrigo Weber, Blanca Rodriguez

A Model for Zebrafish Ventricular Action Potential 772
Ludovica Cestariolo, Marina Battaller Martinez, Jose M Ferrero, Jose F Rodriguez Matas

Characterization of Heart Rate Variability Dynamics in Heart Failure Patients Admitted to Intensive Care Unit 776
Maximiliano Mollura, Christian Niklas, Stefanie Messner, Markus A Weigand, Jan Larmann, Riccardo Barbieri

Pulse Wave Analysis of Photoplethysmography Signals to Enhance Classification of Cardiac Arrhythmias 780
Loïc Jeanningros, Fabian Braun, Jérôme Van Zaen, Mathieu Le Bloa, Alessandra Porretta, Cheryl Teres, Claudia Herrera, Giulia Domenichini, Patrice Carroz, Denis Graf, Patrizio Pascale, Jean-Marc Vesin, Jean-Philippe Thiran, Etienne Pruvot, Mathieu Lemay

N2091S Mutation in L-Type Calcium Channel Promotes Action Potential Alternans in M Cells of Human Ventricle: A Simulation Study 784
Yumin Shen, Na Zhao, Zhipeng Cai, Chengyu Liu, Jianqing Li

A New DDE Smoothing Filter for ECG Signal Denoising 788
Arman Kheirati Roonizi, Roberto Sassi

Cardiopulmonary Analysis of Sleep Apnea Based on Weighted Limited Penetrable Visibility Graph 792
Kejun Dong, Li Zhao, Cairong Zou, Jianqing Li, Chengyu Liu

Cosinor-Based Circadianity of T-Wave Alternans Activity as a Predictor of Sudden Cardiac Death in Heart Failure: A Post-Hoc Analysis of the GISSI-HF Holter Substudy 796
Marcos Usón, Johannes De Bie, Roberto Maestri, Maria Teresa La Rovere, Juan Pablo Martínez, Alba Martín-Yebra

Dual Bayesian ResNet: A Deep Learning Approach to Heart Murmur Detection 800
Ben Walker, Felix Krones, Ivan Kiskin, Guy Parsons, Terence Lyons, Adam Mahdi

Validation of a Customized Method for Estimating Electrical Potentials in the Torso from Atrial Signals: A Computational-Clinical Study 804
Camila R Restivo, Gabriel V Costa, Italo Sandoval, Maria S Guillem, João Salinet

Exploring Transfer Learning for Ventricular Tachycardia Electrophysiology Studies 808
Andrea Pitzus, Giulia Baldazzi, Marco Orrú, Alberto Valdes Rey, Graziana Viola, Luigi Raffo, Petar Djuric, Danilo Pani

Effects of Acetylcholine Release Spatial Distribution on the Frequency of Atrial Reentrant Circuits: A Computational Study 812
Chiara Celotto, Carlos Sánchez, Mostafa Abdollahpur, Frida Sandberg, Jose F Rodriguez, Pablo Laguna, Esther Pueyo

Adaptive Filtering Methods for ECG Waveform Restoration During Cardiopulmonary Resuscitation 816
Alvaro Iza, Andoni Elola, Iraia Isasi, Elisabete Aramendi, Trygve Eftestol, Jo Kramer-Johansen, Lars Wik

Incidence of Distinct Repetitive Atrial Activation Patterns as a Metric for Atrial Fibrillation Complexity 820
Ozan Özgül, Ben Hermans, Arne Van Hunnik, Sander Verheule, Ulrich Schotten, Pietro Bonizzi, Stef Zeemering

Segmentation Uncertainty Quantification in Cardiac Propagation Models 824
Jess D Tate, Nejib Zemzemi, Shireen Elhabian, Beáta Ondrušová, Machteld Boonstra, Peter Van Dam, Akil Narayan, Dana H Brooks, Rob S Macleod

Forecasting Aortic Pressure Cross-Cohort with Deep Sequence Models 828
Alan Li, Zihao Zhou, Elise Jortberg, Rose Yu

Uncertainty Quantification of Cardiac Position on Deep Graph Network ECGI 832
Xiajun Jiang, Jess Tate, Jake Bergquist, Akil Narayan, Rob Macleod, Linwei Wang

Regional Segmentation of the Left Atrium: A Preliminary Test in Atrial Fibrillation Patients 836
Sachal Hussain, Matteo Falanga, Claudio Fabbri, Cristiana Corsi

Age-Specific Topology Minimization in a One-Dimensional Model Describing Carotid Haemodynamics 840
Irene Suriani, Sabina Manzari, R Arthur Bouwman, Massimo Mischi, Kevin D Lau

A CNN for COVID-19 Detection Using ECG Signals 844
Federico M Muscato, Valentina D A Corino, Massimo W Rivolta, Pietro Cerveri, Antonio Sanzo, Alessandro Vicentini, Roberto Sassi, Luca T Mainardi

Motion Artifact Detection and Classification for Unobtrusive Cardiorespiratory Signals Using Machine Learning 848
Onno Linschmann, Carl Revander, Steffen Leonhardt, Markus Lueken

Fibrosis Reduces the Coincidence of Repetitive Activation Patterns Between the Coronary Sinus and Atrial Regions in Simulated Atrial Fibrillation 852
Margot Van Montfoort, Victor Marques, Ozan Özgül, Ali Gharaviri, Simone Pezzuto, Angelo Auricchio, Pietro Bonizzi, Ulrich Schotten, Stef Zeemering

Using Signal Quality Assessment (SQA) to Help Sleep Stage Classification 856
Mahtab Mohammadpoor Faskhodi, Miguel Angel García-González

Ensemble Transformer-Based Neural Networks Detect Heart Murmur in Phonocardiogram Recordings 860
Mohanad Alkhodari, Syafiq Kamarul Azman, Leontios J. Hadjileontiadis, Ahsan H. Khandoker

Movement, Sweating, and Contact Pressure as Sources of Heart Rate Inaccuracy in Wearable Devices 864
Michele Orini, Gabrielle Guvensen, Alexandra Jamieson, Nish Chaturvedi, Alun D Hughes

Heart Rate Variability Analysis Reveals a Non-Monotonic Relationship Between Humanin Concentration and Cardiac Autonomic Regulation 868
Hibba Yousef, Ahsan H Khandoker, Samuel F Feng, Mika P Tarvainen, Herbert F Jelinek

Towards the Prediction of Atrial Fibrillation Using Interpretable ECG Features 872
Alexander Hammer, Hagen Malberg, Martin Schmidt

Detection of Heart Murmurs in Phonocardiograms with Parallel Hidden Semi-Markov Models 876
Andrew McDonald, Mark Jf Gales, Anurag Agarwal

Efficiency of Different Heartbeat Detection Methods by Using Alternative Noise Reduction Algorithms 880
Marcus Vollmer, Jader Alexander Giraldo Guzmán

Physiologic Patients' Response to Fluid Administration in Intensive Care Unit 884
Maximiliano Mollura, Claudia Salerni, Li-Wei Lehman, Riccardo Barbieri

Multichannel ECG Filtering: Source Consistency Filtering, Eigenfiltering and Traditional Methods 888
Lorenzo Bachi, Maurizio Varanini, Magda Costi, David Lombardi, Fabio Rangoni, Lucia Billeci

Weakly-Supervised Deep Learning for Left Ventricle Fibrosis Segmentation in Cardiac MRI Using Image-Level Labels 892
Roel C Klein, Florence E Van Lieshout, Maarten Z Kolk, Kylian Van Geijtenbeek, Romy Vos, Samuel Ruiperez-Campillo, Ruibin Feng, Brototo Deb, Prasanth Ganesan, Reinoud Knops, Ivana Isgum, Sanjiv Narayan, Erik Bekkers, Bob De Vos, Fleur V Tjong

Normalisation of Action Potential Data Recorded with Sharp Electrodes Maximises Its Utility for Model Development 896
Yann-Stanislas H M Barral, Liudmila Polonchuk, Gary R Mirams, Michael Clerx, Guy Page, Katrina Sweat, Najah Abi-Gerges, Ken Wang, David J Gavaghan

Autocorrelation Function for Predicting Arrhythmic Recurrences in Patients Undergoing Persistent Atrial Fibrillation Ablation 900
Raquel Cervigón, Eduardo Franco, Samuel Ruipérez-Campillo, Cristina Lozano, Francisco Castells, Javier Moreno

Is the Dominant Frequency Accurate Enough for Atrial Fibrillation Signals? 904
Aline Cabasson, Olivier Meste, Stef Zeemering, Ulrich Schotten, Pietro Bonizzi

A New Approach for Mapping Electrical Conduction in Ventricular Tachycardia..... 908
Claudio Fabbri, Matteo Diani, Nicola Trevisi, Cristiana Corsi

The Effect of Segmentation Variability in Forward ECG Simulation 912
Beata Ondrusova, Machteld Boonstra, Jana Svehlikova, Dana Brooks, Peter Van Dam, Ali Salman Rababah, Akil Narayan, Rob Macleod, Nejib Zemzemi, Jess Tate

Computational Analysis of the Effect of Cardiac Motion on Left Main Coronary Artery Hemodynamics..... 916
Laila Fadhillah Ulta Delestri, Foo Ngai Kok, Amr Al Abed, Socrates Dokos, Mohd Jamil Mohamed Mokhtarudin, Neil W Bressloff, Azam Ahmad Bakir

Circadian Modulation of Electrocardiographic Alternans in Kidney Failure Patients on Dialysis..... 920
Ilaria Marcantoni, Chiara Leoni, Claudia Peroni, Agnese Sbrollini, Micaela Morettini, Laura Burattini

Electrophysiological Closed Loop Model of the Heart as Supporting Tool for Cardiac Pacing 924
Niccolò Biasi, Matteo Mercati, Paolo Seghetti, Alessandro Tognetti

Classification of Phonocardiogram Recordings Using Vision Transformer Architecture 928
Joonyeob Kim, Gibeom Park, Bongwon Suh

Spectral Distribution Complexity of the Surface Fibrillatory Waves Predicts Post-Catheter Ablation Relapse in Persistent Atrial Fibrillation..... 932
Pilar Escribano, Juan Ródenas, Manuel García, Miguel A Arias, José J Rieta, Raúl Alcaraz

Detection of Murmurs from Heart Sound Recordings with Deep Residual Networks..... 936
Lei Hu, Wenjie Cai, Xinyue Li, Jia Li

Heart Murmur Detection Using Wavelet Time Scattering and Support Vector Machines..... 940
Adrian K Cornely, Grace M Mirsky

Emulation of Biological Cells 944
Jerry Jacob, Nitish Patel, Sucheta Sehgal

Greedy Selection of the Torso Electrodes for the Solution of Inverse Problem with a Single Dipole..... 948
Beata Ondrusova, Jana Svehlikova, Milan Tysler, Peter Tino

Improving Aorta Segmentation from Phase Contrast MRI Using Adaptive Velocity-Dependent Weighting on the Deep Learning Output for Magnitude and Phase Images..... 952
Mohamed A Elbayumi, Samira Saraya, Tamer Basha

Utilising Surrogate Models to Approximate Cardiac Potentials When Solving Inverse Problems Via Bayesian Techniques 956
Abbish Kamalakkannan, Peter Johnston, Barbara Johnston

Derivative-Based Inference for Cell and Channel Electrophysiology Models..... 960
Michael Clerx, David Augustin, Alister R Dale-Evans, Gary R Mirams

Derangement of Cardiovascular Regulatory Mechanisms in COVID-19 Patients in Intensive Care Unit and Its Association with Mortality..... 964
Francesca Gelpi, Vlasta Bari, Beatrice Cairo, Beatrice De Maria, Noemi Cornara, Riccardo Colombo, Alberto Porta

Transfer Learning in Heart Sound Classification Using Mel Spectrogram 968
Xin Li, G Andre Ng, Fernando S Schlindwein

Scalable, Multiplatform, and Autonomous ECG Processor Supported by AI for Telemedicine Center 972
Filip Plesinger, Adam Ivora, Eniko Vargova, Radovan Smisek, Jan Pavlus, Zuzana Koscova, Petr Nejedly, Veronika Bulkova, Roman Kozubik, Josef Halamek, Pavel Jurak

Comparison of Newtonian and Non-Newtonian Blood Flow in an Ascending Aortic Aneurysm..... 976
Aleksandra Petuchova, Algirdas Maknickas

Contribution of the Slow Delayed Rectifier K^+ Current to Pacemaker Activity of the Human Sinoatrial Node..... 980
Arie O Verkerk, Ronald Wilders

Effects of Ventricular Myofiber Orientation on Mechanical Function in Human Heart Simulations..... 984
Jonathan Krauß, Tobias Gerach, Axel Loewe

Learning Time-Frequency Representations of Phonocardiogram for Murmur Detection 988
Jae-Man Shin, Seong-Yong Park, Hyun-Seok Kim, Woo-Young Seo, Sung-Hoon Kim

Murmur Detection and Clinical Outcome Classification Using a VGG-Like Network and Combined Time-Frequency Representations of PCG Signals 992
Zhongrui Bai, Baiju Yan, Xiangxiang Chen, Yirong Wu, Peng Wang

Model-Based and Unsupervised Machine-Learning Approaches for the Characterization of Responder Profiles for Cardiac Resynchronization Therapy..... 996
Marion Taconné, Virginie Le Rolle, Alban Gallard, Kimi P Owashi, Adrien Al Wazzan, Elena Galli, Jens-Uwe Voigt, Jurgen Duchenne, Otto Smiseth, Erwan Donal, Alfredo Hernandez

Transfer Entropy for Linear QT Correction Under Stationary and Gaussian Assumptions of the QT/RR Probability Distribution 1000
Massimo W Rivolta

Novel Rank-Based Features of Atrial Potentials for the Classification Between Paroxysmal and Persistent Atrial Fibrillation 1004
Hanie Moghaddasi, Richard C Hendriks, Alle-Jan Van Der Veen, Natasja Ms De Groot, Borbála Hunyadi

Searching for Effective Neural Network Architectures for Heart Murmur Detection from Phonocardiogram..... 1008
Hao Wen, Jingsu Kang

Improving Clinical ECG-Based Atrial Fibrosis Quantification with Neural Networks Through in Silico P Waves from an Extensive Virtual Patient Cohort..... 1012
Claudia Nagel, Johannes Osypka, Laura Anna Unger, Deborah Nairn, Armin Luik, Reza Wakili, Olaf Dössel, Axel Loewe

Multi-Class ECG Feature Importance Rankings: Cardiologists Vs Algorithms..... 1016
Philip J Aston, Temesgen Mehari, Alen Bosnjakovic, Peter M Harris, Ashish Sundar, Steven E Williams, Olaf Dössel, Axel Loewe, Claudia Nagel, Nils Strodthoff

ECG and PPG-Based Hypertension Screening Under Non-Hypertensive Blood Pressure Recordings..... 1020
Jesús Cano, Vicente Bertomeu-González, Lorenzo Fácia, José Moreno-Arribas, Raúl Alcaraz, Josè J Rieta

Simulation Study of the Protective Effect of Drugs in Acute Myocardial Ischemia 1024
Ander Loidi, José M Ferrero

Mechanical Translation of Electrical Abnormalities with a New Electromechanical Model of Human Ventricular Cell 1028
Chiara Bartolucci, Mohamadamin Forouzandehmehr, Michelangelo Paci, Stefano Severi

Impact of Pre-Processing Decisions on Automated ECG Classification Accuracy 1032
Adrian K Cornely, Grace M Mirsky

The Effects of Electrode Configuration on Omnipolar Electrograms: An In-Silico Approach 1036
MK Jothi Letchumy, Joseph Brook, Konstantinos Ntagiantas, Dimitrios Panagopoulos, Danya Agha-Jaffar, Nicholas S Peters, Norman Qureshi, Rasheda A Chowdhury, Chris D Cantwell

Reduced RR Interval Correlations of Long QT Syndrome Patients 1040
Teemu Pukkila, Matti Molkkari, Jiyeong Kim, Esa Räsänen

Modelling the Effect of Intracellular Calcium in the Rundown of L-Type Calcium Current 1044
Aditi Agrawal, Michael Clerx, Ken Wang, Liudmila Polonchuk, David J Gavaghan, Gary R Mirams

Differential Response of Hypertrophic Cardiomyopathy to Ischemia Caused by Remodelling of Late Sodium and Rapidly Delayed Rectifier Channels 1048
James A Coleman, Rubén Doste, Alfonso Bueno-Orovio

Cuffless Hypertension Risk Assessment and the Significance of Calibration 1052
Jesús Cano, Lorenzo Fácia, Fernando Hornero, Philip Langley, Raúl Alcaraz, José J Rieta

Hidden Hazards Beneath Cross-Validation Methods in Machine Learning-Based Sleep Apnea Detection 1056
Daniele Padovano, Arturo Martinez-Rodrigo, Jose M Pastor, Jose J Rieta, Raul Alcaraz

Investigating Phase Coherence Between Respiratory Sinus Arrhythmia and Respiration in Depressed Patients with Obstructive Sleep Apnea Across the Sleep Stages 1060
Yahya Alzaabi, Ahsan H Khandoker

Effect of Contact Force on Local Electrical Impedance in Atrial Tissue - An in Silico Evaluation 1064
Carmen Martínez Antón, Jorge Sánchez, Andreas Heinkele, Laura Anna Unger, Annika Haas, Kerstin Schmidt, Armin Luik, Axel Loewe, Olaf Dössel

Heart Murmur Detection from Phonocardiogram Recordings: The George B. Moody PhysioNet Challenge 2022 1068
Matthew A Reyna, Yashar Kiarashi, Andoni Elola, Jorge Oliveira, Francesco Renna, Annie Gu, Erick A Perez Alday, Nadi Sadr, Ashish Sharma, Sandra Mattos, Miguel T Coimbra, Reza Sameni, Ali Bahrami Rad, Gari D Clifford

Effect of Filtering on Pulse Wave Transit Time Measured by Photoplethysmography 1072
Shangdi Liao, Fei Chen, Haipeng Liu, Dingchang Zheng

Decision Tree-Based Model for Signal Quality Scanning in Wearable ECG 1076
Caiyun Ma, Zhongyu Wang, Meicheng Yang, Jianqing Li, Chengyu Liu

ECG, EEG, Breathing Signals, and Machine Learning: Computer-Aided Detection of Obstructive Sleep Apnea Syndrome and Depression 1080
Mostafa M Moussa, Yahya Alzaabi, Ahsan Khandoker

Segmented-Beat Modulation Method-Based Procedure for Extraction of Electrocardiogram-Derived Respiration from Data Acquired by Wearable Sensors During High-Altitude Activity 1084
Agnese Sbrollini, Danilo Bondi, Sofia Romagnoli, Micaela Morettini, Ilaria Marcantoni, Tiziana Pietrangelo, Vittore Verratti, Laura Burattini

Utilization of Deep Learning and Expert Feature Classifier for Detection of Heart Murmurs 1088
Petr Nejedly, Jan Pavlus, Radovan Smisek, Eniko Vargova, Zuzana Koscova, Ivo Viscor, Pavel Jurak, Filip Plesinger

A Machine Learning Based Approach for Localization of Atrial Tachycardia Origin 1092
Celine Hajjar, Thomas Boudou, Jérôme Kalifa, Julien Seitz, Clément Bars

Heart Murmur Detection in Phonocardiographic Signals Using Breathing Noise Suppression 1096
Kristóf Müller, Márton Áron Goda

Alleviating Effects of Long-QT Syndrome Type 2 by Allele-Specific Inhibition of the KCNH2 Mutant Allele 1100
Ronald Wilders

The Influence of Left Atrial Wall Thickness and Curvature on Wall Strain in Patient-Specific Atrium Models 1104
Tiffany MG Baptiste, Angela Lee, Marina Strocchi, Charles Sillett, Daniel B Ennis, Ulrike Haberland, Ronak Rajani, Aldo Rinaldi, Steven A Niederer

Early Myocardial Infarction Detection with One-Class Classification Over Multi-View Echocardiography 1108
Aysen Degerli, Fahad Sohrab, Serkan Kiranyaz, Moncef Gabbouj

Explainable Deep Learning for Non-Invasive Detection of Pulmonary Artery Hypertension from Heart Sounds 1112
Alex Gaudio, Miguel Coimbra, Aurélio Campilho, Asim Smailagic, Samuel E Schmidt, Francesco Renna

Classification of Fetal Behavioral States by Using 1D-CNN Based on Fetal Electrocardiography 1116
Amna Samjeed, Maisam Wahbah, Leontios Hadjileontiadis, Ahsan H Khandoker

Diffusion Reaction Eikonal Alternant Model: Towards Fast Simulations of Complex Cardiac Arrhythmias 1120
Cristian Barrios Espinosa, Jorge Sánchez, Olaf Dössel, Axel Loewe

A QT Interval Inaccuracy Index (QTI) for Highly Automated TQT Studies 1124
Mously D Diaw, Stéphane Papelier, Alexandre Durand-Salmon, Jacques Felblinger, Julien Oster

Exaggerated Amplitude and Peak Location of Ta Wave in Tachycardia as an Indicator for Atrial Disorders 1128
Arya Bhardwaj, Bala Chakravarthy Neelapu, Kunal Pal, J Sivaraman

Thrombogenesis and Hemodynamics in Left Atrium Under Atrial Fibrillation 1132
João Lameu, Italo Sandoval, João Salinet

Electrocardiogram Analysis Reveals Ionic Current Dysregulation Relevant for Atrial Fibrillation 1136
Albert Dasí, Claudia Nagel, Axel Loewe, Julia Camps, Alfonso Bueno-Orovio, Blanca Rodriguez

Effect of Oxygen Concentration Reduction on Photoplethysmographic Waveform Characteristics 1140
Yang Li, Jianqing Li, Zhengtao Cao, Chengyu Liu

Phonocardiogram Classification Using 1-Dimensional Inception Time Convolutional Neural Networks 1144
Bjørn-Jostein Singstad, Antony M Gitau, Markus Kreutzer Johnsen, Johan Ravn, Lars Ailo Bongo, Henrik Schirmer

Two-Stage Classification for Detecting Murmurs from Phonocardiograms Using Deep and Expert Features 1148
Sara Summerton, Danny Wood, Darcy Murphy, Oliver Redfern, Matt Benatan, Matti Kaisti, David C Wong

CER-S, an ECG Platform for the Management of Continuous ECG Recordings and Databases 1152
Martino Vaglio, Pierre Maison-Blanche, Gianfranco Toninelli, Lamberto Isola, Francesca Ferrari, Fabio Badilini

Depressed Patients Identification Using Cardiovascular Signals 1156
M Sami Zitouni, Ahsan Khandoker

Analysis of P-Wave Changes for Prediction of Atrial Fibrillation Episodes 1160
Cristina Moreno, Alba Martín-Yebra, Aleksei Savelev, Pyotr Platonov, Pablo Laguna, Juan Pablo Martinez

Personalized Modeling of Atrial Activation and P-Waves: A Comparison Between Invasive and Non-Invasive Cardiac Mapping 1164
Patricia Martínez Díaz, Jorge Sánchez, Claudia Nagel, Marta Martínez Pérez, Ismael Hernández Romero, María S Guillem, Olaf Dössel, Axel Loewe

An Optimized Automatic P Wave Delineation Method Based on Phasor Transform 1168
Jiayi Yan, Hanshuang Xie, Huaiyu Zhu, Yamin Liu, Fan Wu, Yun Pan

Electrophysiological Simulation of Maternal-Fetal ECG on a 3D Maternal Torso Model 1172
Julie J Uv, Hermenegild Arevalo

Tilt-Induced Changes in RR Series Characteristics: An AV Node Simulation Study 1176
Felix Plappert, Mikael Wallman, Pyotr G Platonov, Sten Östenson, Frida Sandberg

Atrial Fibrillation Recurrence Risk Prediction from 12-Lead ECG Recorded Pre- And Post-Ablation Procedure 1180
Eran Zvuloni, Sheina Gendelman, Sanghamitra Mohanty, Jason Lewen, Andrea Natale, Joachim A Behar

Conduction System Pacing Versus Biventricular Pacing for Cardiac Resynchronization - Preliminary Electrocardiographic Results 1184
Tadej Žlahtic, David Žižek, Miha Mrak, Anja Zupan Mežnar, Vito Starc

A Workflow for Probabilistic Calibration of Models of Left Atrial Electrophysiology 1188
Sam Coveney, Cesare Corrado, Caroline Roney, Richard D Wilkinson, Jeremy E Oakley, Steven A Niederer, Richard H Clayton

The Nonlinear Dynamic Response of Intrapartum Fetal Heart Rate to Uterine Pressure 1192
Johann Vargas-Calixto, Yvonne Wu, Michael Kuzniewicz, Marie-Coralie Cornet, Heather Forquer, Lawrence Gerstley, Emily Hamilton, Philip Warrick, Robert Kearney

A Human-Based Computational Investigation into Sarcomeric and Ionic Remodelling in Hypertrophic Cardiomyopathy 1196
Alex Lipov, Francesca Margara, Xin Zhou, Blanca Rodriguez, Alfonso Bueno-Orovio

Heart Murmur Detection Using Ensemble of Deep Learning Classifiers for Phonocardiograms Recorded from Multiple Auscultation Locations 1200
Saman Parvaneh, Zaniar Ardalan, Joomyung Song, Kathan Vyas, Cristhian Potes

Arrhythmia Database with Annotated Intracardial Atrial Signals from Pediatric Patients Undergoing Catheter Ablation 1204
Richard Redina, Jakub Hejc, David Pospisil, Marina Ronzhina, Petra Novotna, Zdenek Starek

Cellular Heterogeneity in the Atria: An in Silico Study in the Impact on Reentries 1208
Jordan Elliott, Daniele Cinque, Luca Mainardi, José Félix Rodríguez Matas

Convolutional Neural Network Approach for Heart Murmur Sound Detection in Auscultation Signals Using Wavelet Transform Based Features 1212
Robertas Petrolis, Renata Paukstaitiene, Gabriele Rudokaite, Andrius Macas, Arturas Grigaliunas, Algimantas Krisciukaitis

Exploring Role of Accessory Pathway Location in Wolff-Parkinson-White Syndrome in a Model of Whole Heart Electrophysiology 1216
Karli Gillette, Matthias AF Gsell, Stefan Kurath-Koller, Martin Manninger, Anton J. Prassl, Daniel Scherr, Gernot Plank

Automatic Sleep Arousal Detection Using Heart Rate from a Single-Lead Electrocardiogram 1220
Franz Ehrlich, Johannes Bender, Hagen Malberg, Miriam Goldammer

Outcome Prediction and Murmur Detection in Sets of Phonocardiograms by a Deep Learning-Based Ensemble Approach 1224
Sven Festag, Gideon Stein, Tim Büchner, Maha Shadaydeh, Joachim Denzler, Cord Spreckelsen

A Fractal-Based Approach for Suppressing Chest Compression Noise in ECG Signal 1228
Shengyu Zhang, Mimi Hu, Junbiao Hong, Haoyu Jiang, Xianliang He, Lei Wang

PhysioTag: An Open-Source Platform for Collaborative Annotation of Physiological Waveforms 1232
Lucas McCullum, Hasan Saeed, Benjamin Moody, Diane Perry, Eric Gottlieb, Tom Pollard, Xavier Borrat Frigola, Qiao Li, Gari Clifford, Roger G Mark, Li-Wei H Lehman

Automated Identification of Label Errors in Large Electrocardiogram Datasets 1236
Peter Doggart, Alan Kennedy, Emily Foreman, Dewar Finlay, Raymond Bond

Multi-Task Prediction of Murmur and Outcome from Heart Sound Recordings 1240
Yale Chang, Luoluo Liu, Corneliu Antonescu

Author Index