# 16th International Joint Conference on Biomedical Engineering Systems and Technologies (BIOSTEC 2023)

Volume 4: BIOSIGNALS

Lisbon, Portugal 16-18 February 2023

## **Editors:**

Ioanna Chouvarda Ana Fred Hugo Gamboa

ISBN: 978-1-7138-7654-0

### Printed from e-media with permission by:

Curran Associates, Inc. 57 Morehouse Lane Red Hook, NY 12571



Some format issues inherent in the e-media version may also appear in this print version.

Copyright  $\bigcirc$  (2023) by SCITEPRESS – Science and Technology Publications, Lda. All rights reserved.

Printed with permission by Curran Associates, Inc. (2023)

For permission requests, please contact SCITEPRESS – Science and Technology Publications, Lda. at the address below.

SCITEPRESS – Science and Technology Publications, Lda. Avenida de S. Francisco Xavier, Lote 7 Cv. C, 2900-616 Setúbal, Portugal

Phone: +351 265 520 185 Fax: +351 265520 186

info@scitepress.org

### 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

Email: curran@proceedings.com Web: www.proceedings.com

# **CONTENTS**

### INVITED SPEAKERS

Towards the Virtual Human Simulator Giovanni Saggio	5
Academia and Industry: Partners in Leveraging Engineering, Science and Medicine for Clinical Translation  Elazer Edelman	13
Ground-Truthing in the European Health Data Space  Mireille Hildebrandt	15
Machine Learning Applied to Electronic Health Record Data: Opportunities and Challenges Riccardo Bellazzi	23
PAPERS	
FULL PAPERS	
Constrained ALS for Estimation of Human Upper Limb Synergies Rabya Bahadur and Saeed Ur Rehman	29
Machine Learning Algorithms for Mouse LFP Data Classification in Epilepsy  Antonis Golfidis, Michael Vinos, Nikos Vassilopoulos, Eirini Papadaki, Irini Skaliora and Vassilis Cutsuridis	36
Stylohyoid and Posterior Digastric Measurement with Intramuscular EMG, Submental EMG and Swallowing Sound  Adrien Mialland, Ihab Atallah and Agnès Bonvilain	48
Impact of Body Position on Imaging Ballistocardiographic Signals  Alexander Woyczyk and Sebastian Zaunseder	55
Comparison of the Electrophysiological Myoelectrical Activity Evolution in Induction of Labor with Pharmacological and Mechanical Methods  Alba Diaz-Martinez, Yiyao Ye-Lin, Rogelio Monfort-Ortiz, Javier Garcia-Casado, Iria Rey-Ferreira, Felix Nieto-del-Amor, Vicente Diago-Almela, Jose Luis Martinez-de-Juan and Gema Prats-Boluda	66
Speech-Based Supervised Learning Towards the Diagnosis of Amyotrophic Lateral Sclerosis Ricardo Cebola, Duarte Folgado, André V. Carreiro and Hugo Gamboa	<b>7</b> 4
Event-Related Desynchronization Analysis During Action Observation and Motor Imagery of Transitive Movements  Stefania Coelli, Alessandra Calcagno, Federico Temporiti, Roberto Gatti, Manuela Galli and Anna M. Bianchi	86
Wearable Data Generation Using Time-Series Generative Adversarial Networks for Hydration Monitoring Farida Sabry, Wadha Labda, Tamer Eltaras, Fatima Hamza, Khawla Elzoubi and Qutaibah Malluhi	94

Hallucinated Heartbeats: Anomaly-Aware Remote Pulse Estimation Jeremy Speth, Nathan Vance, Benjamin Sporrer, Lu Niu, Patrick Flynn and Adam Czajka	106
Estimation of Fluid Intake Volume from Surface Electromyography Signals: A Comparative Study of Seven Regression Techniques  Iman A. Ismail and Ernest N. Kamavuako	118
Using Sparse Representation of EEG Signal from a Shallow Sparse Autoencoder for Epileptic Seizure Prediction  Gul Hameed Khan, Nadeem Ahmad Khan, Wala Saadeh and Muhammad Awais Bin Altaf	125
Data Augmentation, Multimodality, Subject and Activity Specificity Improve Wearable Electrocardiogram Denoising with Autoencoders João Areias Saraiva, Mariana Abreu, Ana Sofia Carmo, Ana Fred and Hugo Plácido da Silva	133
SHORT PAPERS	
Assessing Situation Awareness (SA) Using Single- or Dual-Location functional Near Infrared Spectroscopy (fNIRS)  Bethany K. Bracken, Aaron Winder, Brandon Hager, Mica R. Endsley and Elena K. Festa	149
AI and IoT Enabled Sleep Stage Classification  Dimitrios Zografakis, Panagiotis Tsakanikas, Ioanna Roussaki and  Konstantina-Maria Giannakopoulou	155
Comparison of Machine Learning Algorithms for Human Activity Recognition Hassan Ashraf, Olivier Brüls, Cédric Schwartz and Mohamed Boutaayamou	162
Spontaneous Cardiac-Locomotor Coupling in Healthy Individuals During Daily Activities Aurora Rosato, Matilda Larsson, Eric Rullman and Seraina A. Dual	170
Machine Learning Algorithm Development and Metrics Extraction from PPG Signal for Improved Robustness in Wearables  Pedro Veiga, Rui Varandas and Hugo Gamboa	178
Annotation-Based Evaluation of Wrist EDA Quality and Response Assessment Techniques E. Pattyn, E. Lutin, A. Van Kraaij, N. Thammasan, D. Tourolle, I. Kosunen, D. Tump, W. De Raedt and C. Van Hoof	186
Prediction of Sleep Stages Based on Wearable Signals Using Machine Learning Techniques Rodrigo Duarte Braga, Daniel Osório and Hugo Gamboa	195
Depression in Obstructive Sleep Apnea Patients: Is Using Complex Deep Learning Structures Worth It?	203
Mostafa Moussa, Yahya Alzaabi and Ahsan Khandoker	
Spectral Analysis of Cardiogenic Vibrations to Distinguish Between Valvular Heart Diseases Ecem Erin and Beren Semiz	212
Arrythmia Classification Using MATLAB® Classification Learner App Cesar N. Silva, Fernanda F. Lopes, Jefferson A. Matos and Maria Claudia F. Castro	220
Description of PD Phonation in Terms of EEG-Related Frequency Bands Pedro Gómez, Jiří Mekyska, Luboš Brabenec, Patrik Šimko, Irena Rektorová, Andrés Gómez and Victoria Rodellar	226

Hybrid Improved Physarum Learner for Structure Causal Discovery  Joao Paulo Soares, Vitor Barth, Alan Eckeli and Carlos Dias Maciel	234
Deep Minutiae Fingerprint Extraction Using Equivariance Priors  Margarida Gouveia, Eduardo Castro, Ana Rebelo, Jaime S. Cardoso and Bruno Patrão	241
Study of Uncertainty Quantification Using Multi-Label ECG in Deep Learning Models Raquel Simão, Marília Barandas, David Belo and Hugo Gamboa	252
The Subspace Regularization Method Improves ErrP Detection by EEGNET in BCI Experiments Andrea Farabbi and Luca Mainardi	260
Multimodal Stress Classification Based on Biosignals Extracted from Smart Devices and Electromyography  Maria Justino, Phillip Probst, Daniel Zagalo, Cátia Cepeda and Hugo Gamboa	265
Analysis of Postural Variability of Office Workers Using Inertial Sensors Fábio Mendes, Phillip Probst, Eduarda Oliosi, Luís Silva, Cátia Cepeda and Hugo Gamboa	273
Automated Detection of Decision-Making Style, Based on Users' Online Mouse Pointer Activity Marcus Cheetham, Catia Cepeda, Hugo Gamboa, Christoph Hoelscher and Seyed Abolfazl Valizadeh	281
Class-wise Knowledge Distillation for Lightweight Segmentation Model Ryota Ikedo, Kotaro Nagata and Kazuhiro Hotta	287
Fall Risk Assessment Using Wearable-Based Turn Detection: Comparison of Different Algorithms During Real-World Monitoring  Jose Albites-Sanabria, Pierpaolo Palumbo, Stefania Bandinelli, Luca Palmerini and Lorenzo Chiari	294
Content Based Image Retrieval Using Depth Maps for Colonoscopy Images  Md Marufi Rahman, JungHwan Oh, Wallapak Tavanapong and Piet C. de Groen	301
Correlating EEG Signals and Electrode Locations by Means of Multidimensional Scaling Lucía Rodríguez-Giraldo and Juan P. Ugarte	309
Towards Lung Cancer Staging via Multipositional Radiomics and Machine Learning Dimitris Fotopoulos, Dimitris Filos, Ekaterini Xinou and Ioanna Chouvarda	317
An RFID Based Localization and Mental Stress Recognition System Using Wearable Sensors Mhd. Wasim Raed, Semih Yön, Ali Güneş, Igor Kotenko, Elena Fedorchenko and Anna Polubaryeva	325
A Rank Aggregation Algorithm for Performance Evaluation in Modern Sports Medicine with NMR-based Metabolomics <i>V. Vigneron and H. Maaref</i>	332
Classification of HCI Datasets Using Information Fusion and Weighted Frechet Distance Aleksandar Jeremic and Huaying Li	340
Reflecting on the Status Quo of Nonverbal Human-Machine Interaction Fábio Barros, António Teixeira and Samuel Silva	344
Heterogeneous Inertial Measurement Units in Motion Analysis Filip Malawski and Natalia Paruzel-Satława	351
Redundancy and Novelty Between ECG Leads Based on Linear Correlation  Utkars Jain, Adam A. Butchy, Michael T. Leasure, Veronica A. Covalesky, Daniel McCormick and Gary S. Mintz	359

Parkinson and REM Sleep Behaviour Disorder: HRV Difference During Polysomnography
Parisa Sattar, Giulia Baldazzi, Nicla Mandas, Elisa Casaglia, Michela Figorilli, Monica Puligheddu 366
and Danilo Pani

AUTHOR INDEX 371