

Feature Engineering and Computational Intelligence in Wearable Health Monitoring

Workshop Synopsis

This half-day workshop is organized by the China Society of Biomedical Engineering and is geared toward graduate students, young researchers and enthusiasts entering the field of Wearable Health Monitoring. Recent advances in wearables and Internet of Things (IoT) devices has led to an explosion of routinely collected individual health data. The use of feature engineering and computational intelligence (commonly known as artificial intelligence (AI)) methods to turn these ever-growing health monitoring data into clinical benefits seems as if it should be an obvious path to take. However, this field is still in its infancy, and lots of essential concepts and method solutions should be clarified in depth. Among them, how to enhance the clinical efficiency of a lot of features from the massive data and how to improve the rationality and interpretability of AI algorithms in practical applications, are two major challenges.

The purpose of this workshop is to provide a platform for discussing the latest progresses, such as wearable device development, feature engineering and computational intelligence techniques for wearable health monitoring, and exploring the new solutions, with an emphasis on how these methods can be efficiently used on the emerging need and challenge -- dynamic, continuous & long-term individual health monitoring and real-time feedback, aiming to provide a “snapshot” of the state of current research at the interface between device development and clinical application, between signal analysis and standard database development. It could help clarify some dilemmas and encourage further investigations in this field, to explore rational applications of feature engineering and computational intelligence in clinical practices for health monitoring.

Chair: Prof. Guangzhi Wang, Tsinghua University
Vice President of Chinese Society of Biomedical Engineering

Co - Chair: Chengyu Liu, Southeast University

List of Speakers:

A. Prof. Yuan-Ting Zhang, City University of Hong Kong, Hong Kong, China

Cardiovascular Health Engineering: From Wearable SUPER-MINDS to MISSION 2024

Dr. Yuan-Ting Zhang is currently the Chair Professor of Biomedical Engineering (BME) at Department of Mechanical and BME, City University of Hong Kong. He was the founding Director of the Key Lab for Health Informatics of Chinese Academy of Sciences (CAS), and the founding Director of the CAS-SIAT Institute of Biomedical and Health Engineering. He was also the founding Director of the Joint Research Center for BME and the first Head of the Division of BME at the CUHK. He was the Sensing System Architect in Sensing Hardware and Health Technology at Apple Inc., Cupertino in California, USA. Before joining the CUHK, he was a Research Associate and Adjunct Assistant Professor between 1989 and 1994 at University of Calgary, Canada. Dr. Zhang serves currently as the Editor-in-Chief for IEEE Reviews in Biomedical Engineering, Chair of 2018 Gordon Research Conference on Advanced Health Informatics, Chair of the Working Group for the development of IEEE Standard on Wearable Cuffless Blood Pressure Measuring Devices (IEEE 1708), Chair of 2016-2018 IEEE Award Committee in BME, and a Member of the Fellow Membership Committee and Award Committee of the International Academy of Medical

and Biological Engineering (IAMBE). Dr. Zhang was the Editor-in-Chief for IEEE Transactions on Information Technology in Biomedicine and the founding Editor-in-Chief of IEEE Journal of Biomedical and Health Informatics.

B. Prof. Paolo Bonato, Harvard Medical School, USA

Using Wearable and mHealth Technologies to Improve the Clinical Management of Patients with Neurological Conditions

Dr. Paolo Bonato serves as Director of the Motion Analysis Laboratory at Spaulding Rehabilitation Hospital, Boston MA. He is an Associate Professor in the Department of Physical Medicine and Rehabilitation, Harvard Medical School, Boston MA, an Adjunct Professor of BME at the MGH Institute of Health Professions, Boston MA, an Associate Faculty Member at the Wyss Institute for Biologically Inspired Engineering, and an Adjunct Professor of Electrical and Computer Engineering at Northeastern University. His research work is focused on the development of rehabilitation technologies with special emphasis on wearable technology and robotics. Dr. Bonato served as the Founding Editor-in-Chief of Journal on NeuroEngineering and Rehabilitation. He serves as a Member of the Advisory Board of the IEEE Journal of Biomedical and Health Informatics and as Associate Editor of the IEEE Journal of Translational Engineering in Health and Medicine. Dr. Bonato served as an Elected Member of the IEEE Engineering in Medicine and Biology Society (EMBS) AdCom (2007-2010) and as President of the International Society of Electrophysiology and Kinesiology (2008-2010). Dr. Bonato served as Chair of the IEEE EMBS Technical Committee on Wearable Biomedical Sensors and Systems in 2008 and as founding member of this committee (2004-2012). He recently served as IEEE EMBS Vice President for Publications (2013-2016). He received the M.S. degree in Electrical Engineering from Politecnico di Torino, Turin, Italy in 1989 and the Ph.D. degree in Biomedical Engineering from Università di Roma "La Sapienza" in 1995.

C. Prof. Milos R. Popovic, University of Toronto, Canada

Functional Electrical Stimulation Therapy: Reaching, Grasping and Walking

Dr. Milos R. Popovic is the Director of Research at the Toronto Rehabilitation Institute, University Health Network; and a fellow of the Canadian Academy of Engineering (CAE) and a Fellow of the American Institute of Medical and Biological Engineering (AIMBE). He is also a Professor in the Institute of Biomaterials and Biomedical Engineering at the University of Toronto. Dr. Popovic's fields of expertise are functional electrical stimulation, neurorehabilitation, neuroprosthetics, brain machine interfaces, modeling and control of linear and non-linear dynamic systems, robotics, power systems, signal processing and safety analysis.

D. Prof. Kang-Ping Lin, Chung Yuan Christian University, Chinese Taipei

Posture Detection and Feature Analysis Using Wearable IMU Sensors for Healthcare Application

Dr. Kang-Ping Lin obtained his Ph.D. degree in 1994 at the University of California, Los Angeles (UCLA) in Biomedical Physics. He is Distinguished Professor of Electrical Engineering at Chung-Yuan Christian University (CYCU). He is now the Director of Technology Translation Center for Medical Device in his university (2011~now). He is the Secretary General and Chair of Publicity Committee in IFMBE (2015~2021). He is also an Administrative Council member, Chair of Public and International Relations Ad-hoc Committee, Congress Coordinating Committee member of IUPESM (2015~2021). He earned awards including the 2016 Chinese Institute of Engineers: Outstanding Engineering Professors Award and the 2017 ACCE (USA) Antonio Hernandez International Clinical Engineering Award. His research interests include handheld medical devices, physiological signal processing, and medical image processing. His current research topics include capillary blood velocity measurement, microcirculation images, and hemodynamic data analysis. In the field of medical devices, he has also focused on

integration of industry, academia and medicine oriented towards being homecare, small, simple and low energy consumption. In addition to his research work, he has long been involved in continuing education and training programs in clinical engineering.

E. Prof. Han Yuan, University of Oklahoma, USA

Wearable multimodal imaging of human brain networks

Dr. Han Yuan received her Ph.D. degree in Biomedical Engineering in 2010 from the University of Minnesota, Twin Cities. She did postdoctoral work at the Laureate Institute for Brain Research and the University of Oklahoma Health Sciences Center for imaging brain in neuropsychiatric and neurological diseases. Currently, she is a tenure-track Assistant Professor in the Stephenson School of Biomedical Engineering at the University of Oklahoma. Her current research focuses on developing multimodal neuroimaging methods using electroencephalogram (EEG), functional magnetic resonance imaging (fMRI) and functional near infrared spectroscopy (fNIRS) for diagnosing and treating brain diseases.

F. Prof. Chengyu Liu, School of Instrument Science and Engineering, Southeast University, China

Wearable ECG Monitoring: Data, Algorithm, Device and Clinical Application

Dr. Liu received his B.S. and Ph.D. degrees in Biomedical Engineering from Shandong University, China, in 2005 and 2010 respectively. He has completed the Postdoctoral trainings at Shandong University in China, Newcastle University in UK and Emory University in USA. He is now the Interim Director of the School of Instrument Science and Engineering in Southeast University, a Professor of the State Key Laboratory of Bioelectronics, and the founding Director of Wearable Heart-Sleep-Emotion Intelligent Monitoring Lab in Southeast University, leading the research works on cardiovascular signals processing, medical device development and clinical applications. He also serves as the founding chair for China Physiological Signal Challenge (from 2018). He is now a member of Federation Journal Committee of International Federation for Medical and Biological Engineering (IFMBE), an Associate Editor of JMBE, JMME, JMIHI, *etc*, an International Advisory Board Member for Physiological Measurement. His research topics include: mHealth and intelligent monitoring, machine learning and big data processing for physiological signals, early detection and device development for cardiovascular diseases. He has published more than 180 original Journal/ Conference papers.

G. Prof. Lei Wang, Shenzhen Institutes of Advanced Technology, Chinese Academy of Sciences, China

Body Sensor Network

Dr. Lei Wang received the B. Eng in Information and Control Engineering and Ph.D. in Biomedical Engineering, in 1995 and 2000, respectively. He was with University of Glasgow and Imperial College London, during 2000-2008. He is now with the Shenzhen Institutes of Advanced Technology, Chinese Academy of Sciences, as a Professor and the Research Director with the Institute of Biomedical and Health Engineering. Dr. Wang's research interests focus on Wearable Body Sensor Networks. He has published more than 200 scientific papers, authored 11 books and book chapters, and been awarded 70 patents. He has rich experiences on managing a group of students and young researchers - at the moment he is coordinating a multi-disciplinary R&D team with two associate professors, two senior engineers, one computer scientist, and several RAs.