Minisyposia

Title: Flexible Neural Interface Devices and Systems

Abstract: Conventional neural devices that interface with the central and the peripheral nervous systems are rigid and bulky. Biological organs and systems, by contrast, are soft, elastic and curved. Flexible interface technologies create new opportunities in measurement/stimulation which derive from unique options in noninvasive, conformal integration with the soft, curved surfaces and the compliant, heterogeneous depths of biological tissues. These technologies offer powerful modes of operation not only in the context of the brain, but also in other parts of the central nervous system and in the peripheral nervous system as well. Beyond their use for basic neuroscience research, the flexible neural interface technologies have significant potential utility in clinical medicine, ranging from diagnostic systems for the surgical treatment of epilepsy to modulatory devices for the mitigation of symptoms of Parkinson's disease. In this minisymposia, we will introduce and discuss recent advances and challenges in soft, flexible neural interface technologies that overcome fundamental limitations of conventional tools and approaches.

List of Speakers:

A. **Nitish Thakor**, National University of Singapore, sinapsedirector@gmail.com

Title of the presentation: Flexible Bidirectional Nerve Interfaces to Restore Function

Bio: Nitish V. Thakor ('F 1994) is the Director the Singapore Institute for Neurotechnology (SINAPSE) at the National University of Singapore and also a Professor of Biomedical Engineering at Johns Hopkins University in the USA. His expertise is in the field of Neurotechnology and Medical Instrumentation. He has pioneered many technologies for brain monitoring to prosthetic arms and neuroprosthesis. He is an author of more than 270 refereed journal papers, dozen patents, and co-founder of 3 companies. He is currently the Editor in Chief of Medical and Biological Engineering and Computing, and was the Editor in Chief of IEEE TNSRE from 2005-2011 and presently the EIC of Medical and Biological Engineering and Computing. Dr. Thakor is a recipient of a Research Career Development Award from NIH, a Presidential Young Investigator Award from the NSF, and is a Fellow of the AIMBE, IEEE, Founding Fellow of BMES, and Fellow of IFMBE. He is a recipient of the award of Technical Excellence in Neuroengineering from IEEE Engineering in Medicine and Biology Society, Distinguished Alumnus Award from Indian Institute of Technology, Bombay, India, and a Centennial Medal from the University of Wisconsin School of Engineering.

B. **Polina Anikeeva**, Massachusetts Institute of Technology, anikeeva@mit.edu

Title of the presentation: Flexible Fibers: Multifunctional Tools for Neural Tissue Interrogation and Repair

Bio: Polina Anikeeva received her BS in Physics from St. Petersburg State Polytechnic University in 2003. After graduation she spent a year at Los Alamos National Lab where she worked on developing photovoltaic cells based on quantum dots. She then enrolled in a PhD program in Materials Science at MIT and graduated in January 2009 with her thesis dedicated to the design of light emitting devices based on organic materials and nanoparticles. She completed her postdoctoral training at Stanford University, where she developed devices for optical stimulation and electronic recording from neural circuits. Polina joined the faculty of the Department of Materials Science and Engineering at MIT in July 2011, where she is now a Class of 1942 career development assistant professor. Her lab focuses on the development of flexible

and minimally invasive materials and devices for neural recording, stimulation and repair. Polina is also a recipient of NSF CAREER Award, DARPA Young Faculty Award, and the TR35 among others.

C.   **Jonathan Viventi,** Duke University, j.viventi@duke.edu

Title of the presentation: A low-cost, multiplexed µECoG system for long-term high-density recordings in rodents

Bio: Jonathan Viventi is an Assistant Professor of Biomedical Engineering at Duke University. Dr. Viventi earned his Ph.D. in Bioengineering from the University of Pennsylvania and his M.Eng. and B.S.E. degrees in Electrical Engineering from Princeton University. Dr. Viventi's research applies innovations in flexible electronics, low power analog circuits, and machine learning to create new technology for interfacing with the brain at a much finer scale and with broader coverage than previously possible. He creates new tools for neuroscience research and technology to diagnose and treat neurological disorders, such as epilepsy. Using these tools, he collaborates with neuroscientists and clinicians to explore the fundamental properties of brain networks in both health and disease. His research program works closely with industry, including filing five patents and several licensing agreements. His work has been featured as cover articles in Science Translational Medicine and Nature Materials, and has also appeared in Nature Neuroscience, the Journal of Neurophysiology, and Brain. For these achievements, Dr. Viventi was selected to the 2014 MIT Technology Review "Top 35 Innovators Under 35" and the 2014 Popular Science "Brilliant 10" lists.

D.   **Sung Il Park**, University of Illinois at Urbana-Champaign, femtotechnology@gmail.com

Title of the presentation: Hacking nervous systems: Opportunities and challenges for Soft Wireless Bioelectronics

Bio: Sung Il Park is a postdoctoral research associate of Material science Engineering at the University of Illinois at Urbana-Champaign. Dr. Park earned his Ph.D. in electrical engineering from Stanford University, his M.S. from the University of Texas at Austin, and B.S.E degree from Hanyang University. His expertise is in biomaterials, low power analog circuits, and wireless power/communications systems, and aims to create new technology, soft wireless bioelectronics, for interfacing with individual neurons in the nerve systems to complex neural circuits in the brain at a much finer scale and broader coverage than previously possible by providing insights of how these tools can be translated into clinical practice. His recent work on a fully implantable wireless stretchable optogenetic systems has been featured in Nature Biotechnology and several news agencies.

Organizer I: **Jae-Woong Jeong, Ph.D.**, IEEE Member

Bio: Dr. Jeong is an Assistant Professor in Electrical, Computer, and Energy Engineering; and Materials Science and Engineering at University of Colorado, Boulder. He received his BS degree from the University of Texas at Austin in 2005, and his MS and PhD degrees from Stanford University in 2008 and 2012, respectively, all in electrical engineering. From 2012 to 2014, he worked as a postdoctoral researcher in the Rogers Research Group at the University of Illinois at Urbana-Champaign. His research focus is in in developing flexible/stretchable bio-integrated electronics.

Organizer II: **Liang Guo, Ph.D.**, EMBS Member

Bio: Dr. Guo is an Assistant Professor in Electrical & Computer Engineering; and Neuroscience at The Ohio State University. He received his B.E. degree in biomedical engineering from Tsinghua University, Beijing in 2004 and his Ph.D. degree in bioengineering from Georgia

Institute of Technology, Atlanta, GA in 2011. From 2011 to 2013, he worked as a Postdoctoral Associate in the Langer Laboratory at MIT. His research interests are in neural interfacing technology and biological circuits engineering as applied to neuroscience and neural prosthetics.

Title: Modeling and Simulation in Clinical Trials and Drug Development

Abstract: This is the third partner session between IEEE/EMBS at EMBC and The Obesity Society. Significant advances have been made in modeling and decision support tools that guide clinical trials, drug interactions, precision medicine and personal interventions. Three speakers will explore a range of prediction applications including use of existing data resources, future weight gain in individuals and live support of clinical trials. The fourth speaker will describe the present and future impact of decision support in designing and conducting clinical trials.

List of Speakers:

    A.   **Steven Smith, MD**, Florida Hospital, Steven.R.Smith.MD@flhosp.org

    Title of the presentation: Practical Application of Modeling and Simulation in Clinical Trials

    Bio: Steven Smith, MD, is the Chief Scientific Officer of Florida Hospital Research Services and Scientific Director of the Sanford-Burnham Translational Research Institute for Metabolism and Diabetes. Dr. Smith earned his medical degree from the University of Texas Health Science Center in San Antonio. Prior to his tenure at Florida Hospital, Dr. Smith was a faculty member at Pennington Biomedical Research Center for 15 years. Dr. Smith's research is focused on cell/molecular biology and clinical care related to obesity, diabetes and the metabolic origins of cardiovascular disease. He is specifically focused on how individuals differ in their ability to adapt to diets high in fat and understanding how obesity leads to type 2 diabetes. In the clinic, Dr. Smith has a special interest in the identification and development of drugs for the treatment of obesity and diabetes. Dr Smith is past President of The Obesity Society (TOS) and in this position initiated the partnership between TOS and IEEE/EMBS.

    B.   **Diana Thomas, PhD**, Montclair State University, thomasdia@mail.montclair.edu

    Title of the presentation: Models to predict body weight from lifestyle

    Bio: Diana Thomas, Ph.D. is a Professor of Mathematical Sciences at Montclair State University and directs the Center for Quantitative Obesity Research and continues as a Research Associate at the New York Obesity Research Center. She received her Bachelor of Arts at the University of Montana in 1991 and PhD in 1996 from the Georgia Institute of Technology. Her prior academic appointments include New Jersey City University and the Pennington Biomedical Research Center / Louisiana State University. Dr Thomas's work focuses on models to predict and support individual weight management involving dietary adherence, time series projections, as well as assessing macro trends in weight and body composition.

    C.   **Mirjam Trame**, Pharm.D., Ph.D., University of Florida, mtrame@cop.ufl.edu

    Title of the presentation: Mining Adverse Event Databanks to Inform Complex Systems Pharmacology Models

    Bio: Mirjam Nadine Trame, Pharm.D., Ph.D is an Assistant Professor at the University of Florida, College of Pharmacy, Department of Pharmacometrics & Systems Pharmacology. She also holds an Adjunct Faculty appointment at the Translational Research Institute for Metabolism and

Diabetes at Florida Hospital, Orlando were she studies the complex mechanism regulating macronutrient metabolism, body composition and energy expenditure using mathematical modeling. Besides studying human metabolism, Dr. Trame researches the application of quantitative analysis tools (pharmacometrics, PBPK and systems pharmacology) to address clinically relevant research questions in the area of diabetes, obesity, energy expenditure modeling in different diseases, antithrombotic therapy, neurodegenerative diseases, rare diseases, drug induced nephrotoxicity, pediatrics, cardiovascular and drug safety, cystic fibrosis, and translational research. She received her B.S. in Pharmaceutical Sciences from the Westfälische-Wilhelms Universität in Münster, Germany in 2006 and her license to practice as a pharmacist in Germany in 2007. In addition, she earned her Pharm.D. degree from the University of Florida in 2010 and her Ph.D. in Clinical Pharmacology and Pharmacokinetic-Pharmacodynamic (PK/PD) modeling from the Westfälische-Wilhelms Universität in Münster, Germany in 2011. During her Ph.D., she modeled data regarding Therapeutic Drug Monitoring of drugs used in pediatric oncology, focusing on Busulfan, Dimethylacetamide, and Enoxaparin for treatment individualization.

D.   Diane R. Mould, PhD, *Projections Research Inc.*, drmould@pri-home.net

Title of the presentation: Clinical Decision Support Tools: The Evolution of a Revolution

Abstract: Dashboard systems for clinical decision support integrate data from multiple sources. These systems, the newest in a long line of dose calculators and other decision support tools, use Bayesian approaches to fully individualize dosing using information gathered through therapeutic drug monitoring. In one application, treating inflammatory bowel disease patients with infliximab, dashboards may reduce therapeutic failures and reduce treatment costs.

Bio: Dr Diane Mould obtained her bachelors degree at Stevens Institute of Technology in 1984 in Chemistry and Chemical Biology. She received her PhD in Pharmaceutics and Pharmaceutical Chemistry at The Ohio State University (OSU) in 1989. She spent 25 years as a pharmacokineticist in industry where she specialized in population pharmacokinetic / pharmacodynamic modeling and was an associate Research Professor at Georgetown University. She has conducted population PK/PD analyses of hematopoietic agents, monoclonal antibodies, anti-cancer and anti-viral agents, antipsychotic, cardiovascular, and sedative/hypnotic agents. Dr Mould is involved in clinical trial simulation and optimal study design in drug development. She was a member of the Scientific Advisory Group for PharSight, where she assisted in development of clinical trial simulation software. Currently, Dr Mould is president of Projections Research Inc., a consulting company offering pharmacokinetic and pharmacometric services. She has published 60 peer-reviewed articles, 14 chapters, made 95 national and international presentations and presented 6 podium sessions on advanced modeling and simulation approaches. Dr Mould has authored 86 posters at both national and international meetings. She is an adjunct professor at the University of Rhode Island (URI), OSU, and the University of Florida, and teaches an annual class on disease progression modeling at the National Institutes of Health. Dr Mould taught 9 courses (OSU, URI and SUNY Buffalo) on specialized aspects of population pharmacokinetic and dynamic modeling. She is a member of the editorial board for Journal of Pharmacokinetics and Pharmacodynamics, Clinical Pharmacology and Therapeutics, and Clinical Pharmacology and Therapeutics Pharmacometrics and Systems Pharmacology. Dr. Mould is a member of the Board of Regents for the American College of Clinical Pharmacology and is chairman of the Publications committee for this organization. She is a Fellow of the American College of Clinical Pharmacology and of the American Association of Pharmaceutical Sciences.

Organizer I: **Jon K. Moon, PhD**

Bio: Jon Moon is a Senior member of IEEE/EMBS and a Fellow of the Obesity Society. He is President of MEI Research, Ltd. At 6016 Schaefer Rd, Edina, MN 55436 USA, jmoon@meinergy.com, Tel: +1 (952) 373-1636, Fax: +1 (952) 400-5832.

Organizer II: **Professor May D. Wang, PhD**

Bio: Associate Professor of Biomedical Engineering and Electrical and Computer Engineering, Georgia Institute of Technology and Emory University. Kavli Fellow, Fellow of The American Institute for Medical and Biological Engineering (AIMBE).

Title: **Next generation electroencephalography recording electrodes**

Abstract: Electroencephalography (EEG) is the monitoring of a subject's 'brainwaves' by placing small metal electrodes on the scalp, of key use in epilepsy diagnosis and brain-computer interfaces. Traditional EEG systems are limited by the requirement to have a 'wet' gel to make a good contact with the scalp through hair. This gel: takes a long time to apply; leaves a mess; and dries out over time, limiting how long EEG recordings can be performed for.

In recent years 'dry' EEG electrodes have been proposed and are now available commercially. Generally these are based upon 'fingers' that can penetrate the hair and make direct contact with the scalp. Nevertheless, the vast majority of EEG experiments still make use of traditional wet electrodes. While dry fingered electrodes fundamentally allow gel-free EEG, the quality of the contact (contact noise, half-cell potential, and baseline wander) is a major obstacle to their wider use.

This mini-symposium will explore new and emerging techniques that go beyond the 'dry finger' approach for EEG electrodes.

This is intrinsically a cross-disciplinary effort:

*New materials for tattoo/conformal substrates allow superior quality connections.
*New manufacturing approaches allow 3D/inkjet printed electrodes made in real-time with customised sizes and shapes.
*Novel signal processing allows more information to be extracted from poorer quality dry electrode EEG traces.
*Novel EEG system design, using non-conventional locations such as the ear, eliminates the need for recording through hair completely.

Only by working collectively across these research fronts can the required step change in next generation electrode performance be obtained. This mini-symposium will give an overview of these cross-disciplinary topics, exploring how the different techniques can be used together.

List of Speakers:

A. **Alexander J. Casson,** University of Manchester, alex.casson@manchester.ac.uk

Title of Presentation: Epidermal conformal electrodes and 3D printed EEG electrodes

Bio: Alexander J. Casson is a lecturer in the Sensing, Imaging and Signal Processing group at the University of Manchester. His work focuses on electrophysiological monitoring (EEG and ECG) creating new hardware and software to enable robust outof- the-lab monitoring. This research has led to more than 50 publications and prizes including an IET award for the best young biomedical engineer. Dr. Casson has presented in mini-symposiums at EMBC every year since 2010, and organized EMBC mini-symposiums on "mHealth review" and "Bringing out science in mHealth" in 2013 and 2014 respectively.

B. **Danilo Mandic,** Imperial College London, d.mandic@imperial.ac.uk

Title of Presentation: Signal processing for EEG analysis from memory foam in-ear electrodes

Bio: Danilo Mandic is Professor of Signal Processing at Imperial College London. He is the pioneer of in-ear EEG, placing electrodes in the ear canal and creating signal processing to allow the extraction of auditory steady state potentials from these electrodes. He has written over 100 publications on a variety of aspects of signal processing and a research monograph on recurrent neural networks. Professor Mandic is a Fellow of the IEEE and has been a Guest Professor at the Catholic University Leuven, Leuven, Belgium, and Frontier Researcher at the Brain Science Institute RIKEN, Tokyo, Japan.

C.   **Maarten De Vos,** University of Oxford, maarten.devos@eng.ox.ac.uk

Title of Presentation: Screen printed EEG electrodes

Bio: Professor De Vos leads the Computational Intelligence in BIomedical Monitoring lab at the University of Oxford. They have recently demonstrated screen printed EEG electrodes, and suitable signal processing, for behind the ear EEG in a standard hearing aid shell. His work on "How about taking a low-cost, small, and wireless EEG for a walk?" has been cited more than 100 times. Processor De Vos is a member of the IEEE and on the IEEE machine learning for signal processing technical committee.

D.   **Rob Rubio**, Advanced Brain Monitoring, rrubio@b-alert.com

Title of Presentation: Easy penetration through hair using pre-gelled finger-less EEG electrodes

Bio: Rob Rubio is senior director of neurotechnology innovation at Advanced Brain monitoring. Widely known for their X-series of EEG amplifiers Advanced Brain monitoring is one of the leading providers of highly portable EEG equipment based upon pre-gelled hydro-gel electrodes rather than dry electrodes. Breaking the misconceptions and hidden expectations people have for dry electrodes is a key part of their business model. Rob Rubio obtained an MBA from the UCLA Anderson School of Management in 2010 and has worked with Advanced Brain monitoring since then.

Organizer I: **Alexander J. Casson**-IEEE Senior Member

Bio: AJC is a lecturer at the University of Manchester creating next generation electroencephalography and electrocardiography systems. Best known for his work on "Wearable Electroencephalography" published in IEEE Pulse, AJC received the 2013 IET award for the best young biomedical engineer and has organised mini-symposiums at EMBC every year since 2012.

Title: Advancing the Clinical / Physiological Interpretation and Relevance of Heart-Induced Body Vibration Measurements (Ballistocardiography and Seismocardiography)

Abstract: The ballistocardiogram (BCG) and seismocardiogram (SCG) are a class of cardiogenic vibration signals that can potentially be used for assessing the mechanical aspects of cardiovascular health outside of clinical settings, and even in low resource or extreme environment settings. The BCG represents the movements of the whole body in response to the heartbeat; the SCG the local movements of the chest wall associated with the heartbeat. Recently, over the past decade, novel sensing systems have been developed for measuring BCG and SCG signals using unobtrusive hardware such as wearable accelerometers, weighing scales, chairs, and beds. With these advances in the tools available for measuring BCG and SCG signals ubiquitously, the field is poised for novel technologies for processing and interpreting the signals and extracting salient features for subsequent human health and performance applications. This special session is focused on

bringing together the leading researchers in the BCG / SCG research areas to present their latest findings and techniques related to the topic of clinical / physiological interpretation and relevance of BCG and SCG signals.

List of Speakers:

A. **M. Di Rienzo**, Fondazione Don Carlo Gnocchi, mdirienzo@dongnocchi.it

Title of Presentation: Changes in the Seismocardiogram Waveform from Different Chest Locations

Bio: Marco Di Rienzo received his MSc degree in Electronic Engineering from the Politecnico of Milan, Italy in 1980. He is coordinator of technology research in cardiovascular, sensors and telemedicine areas of Fondazione Don Gnocchi. He is also Adjunct Professor, Faculty of Medicine at the University of Milan. His research interests are in signal processing, cardiovascular physiology, microgravity physiology, wearable systems and seismocardiography

B. **O. T. Inan**, Georgia Tech, inan@gatech.edu

Title of Presentation: Preliminary Results from Wearable BCG Measurements in a Heart Failure Population during Six Minute Walk Tests

Bio: Dr. Inan received his BS, MS, and PhD in Electrical Engineering from Stanford University in 2004, 2005, and 2009, respectively. He is an Assistant Professor of Electrical and Computer Engineering, and an Adjunct Assistant Professor of Biomedical Engineering, at the Georgia Institute of Technology. His group researches non-invasive physiological sensing systems for cardiovascular monitoring, joint health rehabilitation, and pediatric bioengineering.

C. **Jin-Oh Hahn,** University of Maryland

Title of Presentation: Elucidating the Physiological Origin of the Ballistocardiogram

Bio: Jin-Oh Hahn is an Assistant Professor of Mechanical Engineering at the University of Maryland. He received his BS and MS from Seoul National University, and his PhD from the Massachusetts Institute of Technology. He was awarded the US Office of Naval Research Young Investigator Program Award in 2014, and the Young Investigator Grant Award from the Korean-American Scientists and Engineers Association in 2013. His research interests related to health include Dynamic Systems and Control, and Modeling, Identification and Control in Biomedicine and Biomedical/Bionic Systems.

D. *Alireza Akhbardeh*

Title of Presentation: Feasibility Analysis of Detecting Respiratory Phases by fusing Electromechanical Signals Recorded from the Chest

Bio: Dr Alireza Akhbardeh received his PhD in 2007 fro Tampere University of Technology, Finland. His PhD thesis was on development of a new machine learning techniques for analysis of ballistocardiogram signals recorded from chairs. He then joined Johns Hopkins University in 2009 as postdoctoral fellow followed by tenure track faculty position.

E. **Kouhyar Tavakolian,** University of North Dakota

Title of Presentation: A Combined System using Seismocardiogram and Pulse-Plethysmogram to Detect Blood Volume Shift Induced by Lower Body Negative Pressure

Bio: Kouhyar Tavakolian is an Assistant Professor at Electrical Engineering Department at University of North Dakota. Prior to joining UND he was Postdoctoral Fellow at University of British Columbia. He received his PhD from Simon Fraser University in Canada in 2010. His area of research is biological signal processing with special focus on cardiac mechanical signals and non-invasive cardiology techniques.

F.   Enrico Caiani

Title of Presentation: Non-Linear Averaging of Ballistocardiogram Signal for Evaluating Cardiac Performance under Different Respiratory Maneuvers

Bio: Enrico G. Caiani is Associate Professor at the Department of Electronics, Information and Biomedical Engineering at Politecnico di Milano. In 2014, he also received the Italian Certification for tenured Full Professorship. Currently, he is the Principal Investigator of several international projects in the context of bed-rest studies supported by the European Space Agency, focusing on the evaluation of changes induced by microgravity exposure on the electro-mechanical function of the heart, and co-Investigator of the project "3D Ballistocardiography" (PI P.F. Migeotte). Since 2014, he serves as Vice- Chairman (Chairperson elect 2016-2018) of the Working Group on e-Cardiology of the European Society of Cardiology.

Organizers I: **Marco DiRienzo-**IEEE Member, EMBS Member

Bio: Marco Di Rienzo received his MSc degree in Electronic Engineering from the Politecnico of Milan, Italy in 1980. He is coordinator of technology research in cardiovascular, sensors and telemedicine areas of Fondazione Don Gnocchi. He is also Adjunct Professor, Faculty of Medicine at the University of Milan. His research interests are in signal processing, cardiovascular physiology, microgravity physiology, wearable systems and seismocardiography.

Organizers II: **Omer T. Inan**-IEEE Senior Member, EMBS Member

Bio: Dr. Inan received his BS, MS, and PhD in Electrical Engineering from Stanford University in 2004, 2005, and 2009, respectively. He is an Assistant Professor of Electrical and Computer Engineering, and an Adjunct Assistant Professor of Biomedical Engineering, at the Georgia Institute of Technology. His group researches non-invasive physiological sensing systems for cardiovascular monitoring, joint health rehabilitation, and pediatric bioengineering.

Title: Recent Advances on Cuff-Less Blood Pressure Measurement Technology I

Abstract: Cuff-less blood pressure (BP) monitoring is expected to improve hypertension detection and control and may now be feasible due to recent technological advances such as in wearable sensing. As a result, cuff-less BP monitoring technology is being widely pursued at present. This topic is of great interest to the attendees of the IEEE EMBC. In the Chicago meeting, we organized a MS on the topic, and attendees were standing outside of the room to listen. In the Milan meeting, we coorganized and chaired three sessions on the topic, and the large rooms were filled to capacity. Together with Drs. Jin-Oh Hahn and Lalit Mestha, we propose two MS on recent advances on cuff-less BP monitoring technology for the Orlando meeting. Half the speakers are not regular attendees of the IEEE EMBC. This particular MS represents part one and covers technology based on ultrasound and applanation tonometry.

List of Speakers:

A.   **Brian W. Anthony**, MIT, banthony@mit.edu

Title of Presentation: Blood pressure estimation using ultrasound and simple finite element models

Bio: With over 20 years of experience in product realization, Dr. Anthony designs instruments and techniques to monitor and control physical systems. His work involves systems analysis and design, calling upon mechanical, electrical and optical engineering, along with computer science and optimization, to create solutions. The focus of Dr. Anthony's research is in computational instrumentation - the design of instruments and techniques to measure and control complex physical systems. His research includes the development of instrumentation and measurement solutions for manufacturing systems and medical diagnostics and imaging systems. In addition to his academic work, he has extensive experience in market driven technology innovation, product realization, and business entrepreneurship and commercialization at the intersection between information technology and advanced manufacturing.

B.   **Jayaraj Joseph**, Indian Institute of Technology Madras, jayaraj@htic.iitm.ac.in

Title of Presentation: Multi modal compliance probes for calibration free cuffless BP evaluation

Bio: Jayaraj Joseph received his bachelor's degree in Electronics and Instrumentation from the College of Engineering, Trivandrum in 2006. He completed his PhD in Electrical Engineering from Indian Institute of Technology, Madras in 2011. His doctoral research involved designing novel transducers and developing intelligent systems for non-invasive evaluation of arterial stiffness for cardiovascular screening. Two patents were filed based on his doctoral research, and he was awarded the silver medal for the best PhD thesis in Electrical Engineering in inter-disciplinary areas of research. Following a brief stint at the Centre for Industrial Consultancy and Sponsored Research (IC&SR) at IIT Madras, where he worked on various socially relevant projects such as renewable energy from ocean waves collaborating with the National Institute of Ocean Technology (NIOT) and development of mobile cataract surgery units in collaboration with Sankara Nethralya, he joined the Healthcare Technology Innovation Centre at IIT Madras in 2012. He is currently the Systems Architect at HTIC, and deals with hardware projects involving sensors and instrumentation, system integration and medical device development. He performs academic research in collaboration with research scholars and students at IITM, and translational R&D which involve solution development for industry partners. The major projects executed in HTIC under his guidance include the Mobile Eye Surgical Unit – the country's first mobile platform for performing surgeries to enable affordable and accessible cataract surgery to rural India and ARTSENS - an image-free technology for non-invasive measurement of arterial stiffness for use in cardiovascular screening. His current projects include affordable point of care diagnostics devices, cuff less blood pressure monitoring, cost – effective bio-parameter monitoring solutions, technological innovations for practical, usable infant care systems, effective design of neonatal transport units, wearable health monitors etc. His main research interests apart from biomedical instrumentation include automated test and measurement, virtual instrumentation, and renewable energy resources (specifically the utilization of ocean-wave-energy).

C.   **David F. Lemmerhirt**, Sonetics Ultrasound, Inc., dlemmerh@soneticsultrasound.com

Presentation of Title: Cuff-less blood pressure monitoring using ultrasound

Bio: David F. Lemmerhirt (S'98-M'05) received the BSEE degree from UIUC in 1997 and the MS and PhD degrees in EE from the University of Michigan, Ann Arbor in 1999 and 2005. He currently holds senior engineering positions at Endra, Inc. (2014-present) and Sonetics Ultrasound, Inc. (2004-present), both involving development of novel ultrasound devices for medical imaging and physiological measurements. His research interests include 3D ultrasound

imaging, thermo-acoustic imaging, blood-pressure and blood-flow measurement, and MEMS-based ultrasound transducer design and manufacturing. He holds seven U.S. patents and has authored multiple publications in the fields of medical ultrasound, microsystems and solid-state electronics.

D.   **Sanjay Mehrotra**, Northwestern University, mehrotra@northwestern.edu

Presentation of Title: Tonometry based blood pressure measurements using a new sensor design

Bio: Sanjay Mehrotra is a professor of Industrial Engineering and Management Sciences at Northwestern University. He has made seminal methodological contributions in the area of data driven decision making, and has applied these methodologies to healthcare. He directs the Center for Engineering and Health at Northwestern. He has been a chair of the Optimization Society in Institute for Operations Research and Management Sciences.

E.   **Anamika Prasad**, Indian Institute of Technology Delhi, aprasad@am.iitd.ac.in

Presentation of Title: Development of cuffless noninvasive blood pressure measurement using radial artery

Bio: Dr Anamika Prasad is Assistant Professor in the Department of Applied Mechanics at Indian Institute of Technology, Delhi (IIT-Delhi). She is advisory board member of medical device start-ups in bay area (Dovetail care) and India (Aortic Valve), and also serve as grant reviewer for Biotechnology Ignition Grant (BIG, Govt of India). She received her PhD from Massachusetts Institute of Technology (2007) in Materials Science and Mechanics, and bachelor in Civil Engineering from IIT-BHU (1997). She has postdoctoral experience from Stanford University Bioengineering and has served 4+ years in related industry in US and India. Her current research is focused on leveraging mechanics to provide solutions and medical diagnostic tools for low-resource setting. Among other things, she is currently working on Affordable Blood Pressure Measurement Technologies for Low-Resource Settings in India and the US under the Indo-US challenge grant. She has received several awards during her academic career, including Gandhian Young Technology Innovation Award for her ongoing work on bone biomechanics (2015) and first place at International Society of Endovascular Specialists for her earlier work at Stanford University (2011)

Organizer I: **Ramakrishna Mukkamala**, IEEE Member, Michigan State University, rama@egr.msu.edu

Bio: Ramakrishna Mukkamala, Ph.D., is Professor of Electrical and Computer Engineering at Michigan State University, East Lansing, MI, USA. His research interests include hemodynamic monitoring, signal processing, and modeling. He has contributed to the organization of Theme V activities at EMBC more than a decade.

Organizer II: **Omer T. Inan**, IEEE Member, Georgia Institute of Technology, omer.inan@ece.gatech.edu

Bio: Omer Inan, received his BS, MS, and PhD in Electrical Engineering from Stanford University in 2004, 2005, and 2009, respectively. He is currently an Assistant Professor of Electrical and Computer Engineering, and Program Faculty in Bioengineering at the Georgia Institute of Technology. Research interests are in the non-invasive physiological monitoring and wearable sensors. He is Associate Editor for the IEEE JBHI.

Title: Recent Advances on Cuff-Less Blood Pressure Measurement Technology II

Abstract: Cuff-less blood pressure (BP) monitoring is expected to improve hypertension detection and control and may now be feasible due to recent technological advances such as in wearable sensing. As a result, cuff-less BP monitoring technology is being widely pursued at present. This topic is of great interest to the attendees of the IEEE EMBC. In the Chicago meeting, we organized a MS on the topic, and attendees were standing outside of the room to listen. In the Milan meeting, we coorganized and chaired three sessions on the topic, and the large rooms were filled to capacity. Together with Drs. Ramakrishna Mukkamla and Omer Inan, we propose two MS on recent advances on cuff-less BP monitoring technology for the Orlando meeting. Half the speakers are not regular attendees of the IEEE EMBC. This particular MS represents part two and covers technology based on pulse transit time.

List of Speakers:

A.   **Enric Muntane Calvo,** CSEM (Swiss Center for Electronics and Microtechnology), emc@csem.ch

Presentation of Title: New advances on the measurement of blood pressure from reflective photo-plethysmographic signals

Bio: Enric Muntane Calvo received his M.Sc. degree on Telecommunication Engineering from the Universitat Politecnica de Catalunya (UPC) after writing a master thesis on implementation of fast cold synchronization algorithms for GPS. He joined CSEM in 2011 as R&D Engineer in the Signal Processing group, where he has been involved in several projects in the metrology and biomedical fields. He is specialized in the low-level implementation of algorithms either in low power micro controllers, DSP and FPGA platforms.

B.   **Sujay Deb**, Indraprastha Institute of Information Technology, Delhi, sdeb@iiitd.ac.in

Presentation of Title: Cuffless blood pressure estimation using regression-based approach

Bio: Sujay Deb is an Assistant Professor in Electronics and Communication Engineering at Indraprastha Institute of Information Technology, Delhi (IIIT-D). He received Ph.D. from the School of Electrical Engineering and Computer Science, Washington State University, Pullman, WA on May 2012. Before his current position, he worked as an intern at Intel Labs, Hillsboro, OR. His major awards and achievements include DST INSPIRE Faculty Award in 2012; Outstanding Ph.D. student award in Computer Engineering, WSU, 2011; Winner of India-US Grand Challenge Initiative for Affordable Blood Pressure measurement technologies in 2014. His research interests are in the design and development of low-cost biomedical signal acquisition unit for preventive cardiology. Other research interests span the area of "design of novel interconnect architectures for multi-core chips". Specifically, it comprises analysis of Network-on-Chip(NoC) communication fabrics in the presence of long-range millimeter (mm)-wave wireless links.

C.   **Marco Di Rienzo**, Fondazione Don Carolo Gnocchi, mdirienzo@DONGNOCCHI.IT

Presentation of Title: Simultaneous multisite assessment of the pulse transit time

Bio: Marco Di Rienzo received his MSc degree in Electronic Engineering from the Politecnico of Milan, Italy in 1980. He is coordinator of technology research in cardiovascular, sensors and telemedicine areas of Fondazione Don Gnocchi. He is also Adjunct Professor, Faculty of Medicine at the University of Milan. His research interests are in signal processing, cardiovascular physiology, microgravity physiology, blood pressure measurement, wearable systems and seismocardiography.

D.   **Omer T. Inan**, Georgia Institute of Technology, omer.inan@ece.gatech.edu

Presentation of Title: Photoplethysmogram array for high quality distal waveform measurement on a weighing scale

Bio: Omer Inan, received his BS, MS, and PhD in Electrical Engineering from Stanford University in 2004, 2005, and 2009, respectively. He is currently an Assistant Professor of Electrical and Computer Engineering, and Program Faculty in Bioengineering at the Georgia Institute of Technology. Research interests are in the non-invasive physiological monitoring and wearable sensors. He is Associate Editor for the IEEE JBHI.

E. **Ramakrishna Mukkamala**, Michigan State University, rama@egr.msu.edu

Presentation of Title: Contact and noncontact pulse transit time measurements as markers of blood pressure

Bio: Ramakrishna Mukkamala, Ph.D., is Professor of Electrical and Computer Engineering at Michigan State University, East Lansing, MI, USA. His research interests include hemodynamic monitoring, signal processing, and modeling. He has contributed to the organization of Theme V activities at EMBC more than a decade.

Organizer I: **Jin-Oh Hahn**, IEEE Member, University of Maryland, College Park, jhahn12@umd.edu

Bio: Jin-Oh Hahn is an Assistant Professor of Mechanical Engineering at the University of Maryland. His current research interests include systems and controls approach to health monitoring, diagnostics and maintenance of dynamic systems with applications to bio-systems and healthcare domain. He has participated in/contributed to the organization of mini symposia on cuffless blood pressure monitoring since 2014. He is a recipient of the Young Investigator Program Award from the Office of Naval Research in 2014, and the Young Investigator Grant Award from the Korean-American Scientists and Engineers Association in 2013.

Organizer II: **Lalit K. Mestha**, IEEE Fellow, GE Global Research, lalit.mestha@ge.com

Bio: Lalit K. Mestha, PhD, is a Principal Engineer at GE Global Research, a Fellow of IEEE and an Adjunct Professor at Rochester Institute of Technology in Biomedical Engineering with 350 publications (including journals, patents, books & patent applications). Present research is in PTT based blood pressure measurement and security of industrial control systems. Experienced in many engineering disciplines; application of control theory, optimization, optical imaging, signal processing, modeling of human physiological systems, spectral analysis (hyper-spectral) in visible to infrared bands. Before joining GE GRC, he pursued research in human vitals, respiratory, cardiac arrhythmia and cancer detection at PARC with video cameras.

Title: Restoring Human Performance through Physical and Robotic Augmentation

Abstract: This mini-symposia addresses the need to improve the quality of life of persons with disabilities and enhance human performance by understanding biomechanics and by innovation in robotics and assistive technologies. Rehabilitation and therapy play an integral role toward regaining independence, self-reliance and confidence. Multiple fields of engineering and other disciplines

combine to create complex systems for rehabilitation. Such systems provide the necessary tools to optimize the therapy sessions specifically for each patient and evaluate the efficiency of the rehabilitation process. This minisymposia will include talks on rehabilitation using haptics, visual, and physical feedback to retrain individuals to move properly after an injury. It will also include methods to assist individuals during motions in which the individual is unable to perform on their own. An ongoing discussion throughout these talks will focus on involving the user and keeping the needs of the individual at he heart of all rehabilitation research.

List of Speakers:

A. **Dr. Norali Pernalete**, Cal Poly Pomona

Title of the presentation: Integration of Haptics with Visual Feedback Technology for Eye-Hand Coordination Assessment

Bio: Dr Norali Pernalete was born and raised in Venezuela. After obtaining her Ph.D. at the University of South Florida, she became an Assistant Professor in the Electrical and Computer Engineering department at Western Michigan University (WMU) in Kalamazoo. In Fall 2006, she moved to Cal Poly Pomona as an Associate Professor in the Electronics and Computer Engineering Technology program, and was promoted to full Professor in Fall 2012. She has obtained funding from the National Science Foundation-Research to Aid People with Disabilities (NSF-RAPD), and performs collaborative research with Casa Colina Hospital for Rehabilitative Medicine in Pomona, and the USF-CARRT.

B. *Jose Pons*, Neural Rehabilitation Group, Spanish Research Council

Title of the presentation: Smart Wearable Robots with Bioinspired Sensory-Motor Skills

Bio: Prof. Pons obtained his PhD in Physics, Universidad Complutense Madrid, in 1997. In 1998 he was appointed as Postdoctoral Fellow at the Institute for Industrial Automation of the Spanish Council for Scientific Research, CSIC. In 1999 he was awarded a position as Tenured Scientist, in 2007 a position as Research Scientist and eventually in 2008 a position as Full Professor, all of them at the same institution. Prof. J.L. Pons is with CSIC since 1993 and has actively participated in a number of National, European and International RTD projects in the area of rehabilitation robotics, new actuators and control technologies. In particular, he was coordinator of EU GAIT, EU MANUS and EU ESBiRRo projects. In addition, he is currently coordinating of several national scope and European projects, e.g. EU NeuroTREMOR, Biomot, H2R and HYPER.

C. **Prof. Kazuo Kiguchi**, Kyushu University

Title of the presentation: Tremor Suppression With An Upper-Limb Power Assist Robot

Bio: Prof. Kazuo Kiguchi received B.Eng. from Niigata Univ., Japan, M.A. Sc.from Univ. of Ottawa, Canada, and Dr.Eng. from Nagoya Univ., Japan. He is currently a professor at Kyushu Univ., Japan. His research interests are human-assist robots, medical robots, and rehabilitation robots.

D. *Dr. Kyle Reed,* University of South Florida

Title of the presentation: Restoring Symmetry in Asymmetrically-Impaired Individuals

Bio: Kyle B. Reed is an Assistant Professor of Mechanical Engineering at the University of South Florida. He received the B.S. degree from the University of Tennessee, the M.S. and Ph.D. degrees from Northwestern University, and was a postdoctoral fellow in the Laboratory for Computational Sensing and Robotics at The Johns Hopkins University. He has been an

investigator on projects funded by NSF, NIH, OPERF, and industry. His research interests include haptics, human-machine interaction, rehabilitation engineering, medical robotics, and engineering education.

E.   **Dr. Redwan Alqasemi and Dr, Rajiv Dubey**, University of South Florida

Title of the presentation: Interactive Robotic Assistance Using Baxter

Bio: Dr. Redwan Alqasemi has a PhD in Mechanical Engineering in the field of robotics and controls with strong emphasis on mobility and manipulation of robots with various interfaces, including the Brain- Computer Interface. His research interests include autonomous and telerobotic manipulation; haptics; rehabilitation robotics; mechatronics; and controls. Dr. Rajiv Dubey is a Professor and Chair of the Department of Mechanical Engineering and Director of CARRT. His research interests include assistive robotics and prosthetics; robotic simulation, rehabilitation engineering; and robotics in healthcare, space, undersea, and nuclear waste management. He has published over 150 refereed articles and directed over fifty PhD dissertations and MS theses. He was an Associate Editor of the IEEE Journal on Robotics and Automation for eight years and has been on numerous organizing committees for major international conferences in robotics. Dr. Dubey has received $25 million in research funding as a PI from various agencies including NSF, NASA, Department of Defense, Department of Energy, Department of Education, and the private sector.

F.   **Dr. Stephanie Carey**, University of South Florida

Title of the presentation: Development of a Simulation Tool for Upper Extremity Prosthesis

Bio: Dr. Carey has a PhD in Biomedical Engineering. She is an Assistant Research Professor at the University of South Florida and the Research Coordinator for the Center for Assistive, Rehabilitation & Robotics Technologies (CARRT). She has a background in motion analysis, applied biomechanics and prosthetic research. She has been an investigator on projects funded by the U.S. Department of Defense, the Department of Veterans Affairs, the American Academy of Orthotists & Prosthetists, and the Florida Department of Education

Organizer I: **Dr. Stephanie L. Carey**, IEEE Member

Bio: Dr. Carey has a PhD in Biomedical Engineering. She is an Assistant Research Professor at the University of South Florida and the Research Coordinator for the Center for Assistive, Rehabilitation & Robotics Technologies (CARRT). She has a background in motion analysis, applied biomechanics and prosthetic research. She has been an investigator on projects funded by the U.S. Department of Defense, the Department of Veterans Affairs, the American Academy of Orthotists & Prosthetists, and the Florida Department of Education

Organizer II: **Dr. Kyle B. Reed,** IEEE Member

Bio: Kyle B. Reed is an Assistant Professor of Mechanical Engineering at the University of South Florida. He received the B.S. degree from the University of Tennessee, the M.S. and Ph.D. degrees from Northwestern University, and was a postdoctoral fellow in the Laboratory for Computational Sensing and Robotics at The Johns Hopkins University. He has been an investigator on projects funded by NSF, NIH, OPERF, and industry. His research interests include haptics, human-machine interaction, rehabilitation engineering, medical robotics, and engineering education

Title:	Bio-medical Systems - Can you hack them?

Abstract:	Biomedical devices are becoming pervasive in human society – be it wearable fitness trackers or implantable life-assist devices – to provide enabling solutions to many important healthcare needs. With widespread usage of these devices and increasing connectivity built into these extremely personal devices, there is a high risk to information leakage as well as various forms of tampering. While complex security protocols can be designed and implemented in the wireless link from the gateway device to the server, a majority of biomedical devices are not suitable for integrating many existing computer systems security measures. In particular, the implantable and even wearable devices are highly resource-constrained, often relying on harvested energy to power the data collection and transmission. As these devices collect sensitive healthcare-related information and perform life-critical medical support, any breach in their security can lead to catastrophic impact, including loss of life in extreme cases. There is a critical need to analyze the security/trust/privacy issues in various forms of biomedical devices and develop low-cost effective solutions tailored to the specifics needs for these devices. This mini-symposium will bring the experts in system security and biomedical devices to discuss the state-of-the-art about this burning yet often-neglected issue related to the security, trust and privacy of such systems. It will highlight four major areas of ongoing research and underline the scope for innovative solutions in this area, namely, implantable system security, wearable healthcare device security, biometrics for authentication, as well as secure body area networks as an enabling solution for secure trustworthy biomedical devices of future.

List of Speakers:

A. **Anand Raghunathan**, Purdue University

Title of the presentation: Bio-implantable Device Security: Vulnerabilities and Potential Solutions

Bio: Anand Raghunathan received the B.Tech. degree from the Indian Institute of Technology, Madras, India, and the M.A. and Ph.D. degrees from Princeton University, Princeton, NJ. He is currently a Professor in the School of Electrical and Computer Engineering, Purdue University, West Lafayette, IN. Previously, he was a Senior Research Staff Member at NEC Laboratories America, Princeton, NJ, where he led research projects related to System-on-Chip architectures, design methodologies, and design tools. He has co-authored a book High-level Power Analysis and Optimization and six book chapters, and has presented several full-day and embedded conference tutorials in the above areas. He holds or has filed for 20 U.S patents. Dr. Raghunathan has received six best paper awards at leading conferences. He received a Patent of the Year Award (an award recognizing the invention that has achieved the highest impact), and a Technology Commercialization Award from NEC in 2001 and 2005, respectively. He was chosen by MIT's Technology Review among the TR35 (top 35 innovators under 35 years, across various disciplines of science and technology) in 2006, for his work on "making mobile secure." He has been a member of the technical program and organizing committees of several leading conferences and workshops. He has served as Program and General Co-chair for the ACM/IEEE International Symposium on Low Power Electronics and Design, and as Program Co-Chair for the IEEE VLSI Test Symposium. He has also served as Associate Editor of the IEEE Transactions On Computer-Aided Design, the IEEE Transactions on Very Large-Scale Integration (VLSI) Systems, IEEE Design & Test of Computers, and the Journal of Low Power Electronics. He is Vice-Chair of the Tutorials & Education Group at the IEEE Computer Society's Test Technology Technical Council. He was a recipient of the IEEE Meritorious Service Award (2001) and Outstanding Service Award (2004), and was elected a Golden Core Member of the IEEE Computer Society in 2001.

B. **Yier Jin**, University of Central Florida, email:yier.jin@eecs.ecf.edu

Title of the presentation: Hacking Wearable Fitness Trackers

Bio: Yier Jin is currently an assistant professor in the EECS Department at the University of Central Florida. He received his Ph.D. degree in Electrical Engineering in 2012 from Yale University, after earning B.S. and M.S. degrees in Electrical Engineering from Zhejiang University in 2005 and 2007, respectively. His research focuses on the areas of trusted embedded systems, trusted hardware intellectual property (IP) cores and hardware-software co-protection on computer systems. He is also interested in the security analysis on Internet of Things (IoT) and wearable devices, with emphasis on information integrity and privacy protection. He serves and has served on the Organizing Committees and Technical Program Committees of many Conferences and Workshops, such as, DAC, HOST, ISVLSI, ATS, ICCD, etc.

C. **Domenic Forte**, University of Florida

Title of the presentation: Biometrics for Authentication in Resource-Constrained Systems

Bio: Domenic Forte received the B.S. degree from Manhattan College, Riverdale, NY, USA, in 2006, and the M.S. and Ph.D. degrees from the University of Maryland, College Park, MD, USA, in 2010 and 2013, respectively, all in electrical engineering. From 2013 to 2015, he was an Assistant Professor with the Department of Electrical and Computer Engineering, University of Connecticut, Storrs, CT, USA. Since 2015, he has been with the Department of Electrical and Computer Engineering, University of Florida, Gainesville, FL, USA, where he is currently an Assistant Professor. His current research interests include the domain of hardware security and investigation of hardware security primitives, hardware Trojan detection and prevention, security of the electronics supply chain, and anti-reverse engineering. Dr. Forte was a recipient of the Northrop Grumman Fellowship and the George Corcoran Memorial Outstanding Teaching Award from the Department of Electrical and Computer Engineering, University of Maryland. His work has been recognized through several best paper awards and nominations, including Adaptive Hardware Systems 2011 and Design Automation Conference 2012. He has served on the program committees of several workshops and conferences. He serves as the Session Chair for several technical events

D. **Sandeep Gupta**, Arizona State University, email:sandeep.gupta@asu.edu

Title of the presentation: Protect Your Body Sensor Networks

Bio: Sandeep Gupta is a Professor with the School of Computing, Informatics, and Decision Systems Engineering, Arizona State University, Tempe, AZ. He received the B.Tech degree in Computer Science and Engineering (CSE) from Institute of Technology, Banaras Hindu University, Varanasi, India, M.Tech. degree in CSE from Indian Institute of Technology, Kanpur, and M.S. and Ph.D. degree in Computer and Information Science from Ohio State University, Columbus, OH. His current research focuses on dependable, criticality-aware, adaptive distributed systems with emphasis on wireless sensor networks, thermal and power-aware computing and communication, and pervasive healthcare. He has co-authored the book Fundamentals of Mobile and Pervasive Computing, McGraw Hill, and is currently on the editorial board of IEEE Communication Letters, IEEE Transactions on Parallel & Distributed Systems and Springer Wireless Networks. He is a member of the ACM and a senior member of the IEEE. Dr. Gupta heads the IMPACT (Intelligent Mobile and Pervasive Applications and Computing Technologies) Lab at Arizona State University.

Organizer I: **Seetharam Narasimhan**

Bio: Seetharam Narasimhan is a Lead Security Researcher at the SVE Security Center of Excellence, Platform Engineering Group of Intel Corporation, Hillsboro, Oregon, USA. He has a Ph.D. in Computer Engineering from Case Western Reserve University (USA) and a B.E. (Hons.) in Electronics and Telecommunication Engineering from Jadavpur University (India). His research interests include: hardware security, ultralow power and reliable nanoscale circuits, as

well as bio-medical circuits and systems. He is the co-author of three book chapters, and more than 40 publications in international journals and conferences of repute.

Organizer II: **Swarup Bhunia –** IEEE Senior Member

Bio: Swarup Bhunia is a professor in the department of Electrical and Computer Engineering at University of Florida, Gainesville, FL, USA. Prior to this, he served as the T. and A. Schroeder associate professor of Electrical Engineering and Computer Science at Case Western Reserve University, Cleveland, OH, USA. He received his Ph.D. from Purdue University, IN, USA, in 2005, M.Tech. degree from the Indian Institute of Technology (IIT), Kharagpur and B.E. (Hons.) from Jadavpur University, Kolkata, India. His research interests include hardware security and trust, adaptive nanocomputing, low power and robust design and test methodologies, and implantable and wearable electronics. He has over over 200 publications in peer reviewed journals and premier conferences and four books in these areas.

Title: **Advances in Sleep Theranostics I, II & III**

Abstract: The most prevalent forms of sleep disorders include chronic insomnia and sleep-related breathing disorders (SRBD). Obstructive Sleep Apnea (OSA) is the most common form of SRBD that occurs in more than 10% of U.S. adults, with those figures expected to grow with the worldwide obesity pandemic. OSA is associated with increased risk of developing a rapidly expanding list of medical comorbidities such as hypertension, cardiac arrhythmias, ischemic heart disease, stroke, diabetes, learning and attention deficits, and depression and mental illness. This series of 3 back-to-back minisymposia features topranked experts in the fields of cardiorespiratory and sleep research who will present the state-of-the art advances in the development of "smart", low-cost, noninvasive and nonintrusive methods for early detection and diagnosis of SRBD, as well as novel therapeutic approaches for the management of the broad spectrum of these disorders.

List of Speakers:

A. **Richard B. Berry**, M.D., Div. of Pulmonary, Critical Care, and Sleep Medicine, University of Florida, Richard.Berry@medicine.ufl.edu

Title of presentation: Current challenges in diagnosis and treatment of sleep apnea - how technology can help

Bio: Dr. Berry is Professor of Medicine and Medical Director of the Sleep Disorders Center at University of Florida, Gainesville. He is also the Chief of the Pulmonary Section in Malcom Randall Veterans Affairs Medical Center. Dr. Berry is a world-renowned authority on the mechanisms of respiratory arousal from sleep, upper airway physiology, and the treatment of sleep apnea.

B. **Kwangsuk Park**, Ph.D. Dept. of Biomedical Engineering, College of Medicine, Seoul National University, kspark@bmsil.snu.ac.kr

Title of presentation: Nonintrusive estimation of sleep performance parameters

Bio: Dr. Park is Professor and Chair of Biomedical Engineering and Director of the Advanced Biometric Research Center in Seoul National University. He is a member of Korean Society of Medical and Biological Engineering and served as the secretary general of the 2006 World Congress on Medical Physics and Biomedical Engineering. He is also a senior member of EMBS and has served as Associate Editor for IEEE Trans. on Information Technology in Biomedicine

since 2005. His main research area is biological signal measurement and processing for medical diagnostics.

C. **Thomas Penzel**, Ph.D. Interdisciplinary Center of Sleep Medicine, Charite Hospital Berlin, thomas.penzel@charite.de

Title of presentation: Cardiorespiratory markers of sleep-disordered breathing

Bio: Dr. Penzel is a physicist and physiologist. He studies sleep in healthy subjects and patients with   sleep disorders, with a focus on cardiovascular regulation. He has analyzed heart rate variability and blood pressure variability in these subjects. Currently he works at the sleep medicine center in Berlin, Germany as a research director for sleep research on cardiovascular consequences of insomnia and educates medical and engineering students. He is a Senior Member of EMBS and the current chair of the Cardiopulmonary Systems Technical Committee.

D. **Michael C.K. Khoo**, Ph.D. and **Patjanaporn Chalacheva**, Ph.D. Biomedical Engineering Dept., University of Southern California, khoo@usc.edu , chalache@usc.edu

Title of presentation: Model-based biophysical markers of altered autonomic function in sleep apnea and metabolic syndrome

Bio: Dr. Khoo is Professor of Biomedical Engineering and Pediatrics at the University of Southern California (USC). He is an IEEE Fellow and Vice-President for Conferences in EMBS. He was conference chair for EMBC 2012, and a past chair of the EMBS Cardiopulmonary Systems Technical Committee. Dr. Khoo's main research interests include modeling of cardiorespiratory and metabolic control in sleep disorders, autonomic control in sickle cell disease, biomedical signal processing, and noninvasive patient monitoring. Dr. Chalacheva is a Postdoctoral Research Associate in Biomedical Engineering at USC. She is a member of the EMBS Cardiopulmonary Systems Technical Committee, and was previously webmaster for EMBC'12. Her research interests include cardiovascular system modeling, physiological system identification and biomedical signal processing.

E. **Rayleigh Ping-Ying Chiang**, M.D., M.M.S. Institute: Taipei Veterans General Hospital, National Taiwan University, rayleighchiang@ntu.edu.tw

Title of presentation: Diagnosis of Sleep Disorders by Using Textile Sensors

Bio: Dr. Chiang is a sleep specialist and otolaryngologist and is the only scholar who has received the honor of ESRS Board Certificated Grandparent Somnologist from Asia. He expanded the definition of "traditional sleep technology" by publishing the textbook "Introduction to Modern Sleep Technology" under the combination of sleep medicine, engineering, psychology, industrial design and technology management with Springer in the Netherlands in 2012. He is the Vice-Chair of Center of Sleep Medicine, Taipei Veterans General Hospital, the Director of Sleep Technology Special Interest Group of iNSIGHT Center, National Taiwan University. He also serves as the Secretary General, International Sleep Science & Technology Association (ISSTA, www.issta-sleep.org), Germany, and the member of World Sleep Day Committee of WASM. In addition to sleep technology, Dr. Chiang's research interests cover from basic medical science to the bio-signal processing of wearable technology for sleep.

F.   **Raimon Jane**, Ph.D. Institute for Bioengineering of Catalonia (IBEC), the Universitat Politècnica de Catalunya-BarcelonaTech (UPC) and the Biomedical Research Networking Center in Bioengineering, Biomaterials and Nanomedicine (CIBER-BBN), Spain. rjane@ibecbarcelona.eu

Title of presentation: Improving diagnostics and monitoring of obstructive sleep apnea using breath sounds

Bio: Dr. Jané is Director of Research at the UPC-Barcelona Tech and Group Leader of the Biomedical Signal Processing and Interpretation at the IBEC. He is the Coordinator of the Ph.D. program in Biomedical Engineering of the UPC. Currently, Dr. Jané is the President of the Spanish Society of Biomedical Engineering (SEIB). He is a Senior Member of EMBS and member of the Cardiopulmonary Systems Technical Committee. His research interests include multi-modal and multi-scale biomedical signal processing in sleep disorders and cardiorespiratory diseases.

G.   **Dirk Sommermeyer**, Ph.D. Institute for Assistance systems and Qualification (IAQ) e.V., Karlsruhe, Germany   dirk.sommermeyer@iaq-hd.de

Title of presentation: Analysis of photoplethysmographic pulse wave signals measured during sleep

Bio: Dirk Sommermeyer is a scientific director at the Institute for Assistance systems and Qualification (IAQ) e.V. in Karlsruhe, Germany. He studied electrical engineering at the Karlsruhe Institute of Technology (KIT), Karlsruhe, Germany. His research interests focus on in biosignal processing applied on cardiovascular and respiratory signals measured during sleep.

H. **Philip de Chazal**, Ph.D. Charles Perkins Centre, Faculty of Engineering and I.T., Sydney University,
philip.dechazal@sydney.edu.au

Title of presentation: Automated detection of sleep apnea with minimally invasive sensors

Bio: Philip de Chazal is the ResMed Chair of Biomedical Engineering at University of Sydney. He studied electrical engineering at the University of New South Wales in Sydney, Australia. His research interests include signal processing and pattern recognition for biomedical applications with a particular focus on automated detection of sleep disordered breathing.

I.   **Hartmut Schneider**, M.D., Ph.D. Bayview Sleep Disorders Center, Johns Hopkins School of Medicine, hschnei3@jhmi.edu

Title of presentation: Using the pulse wave signal of the finger to determine efficacy of nocturnal oxygen treatment in patients with COPD

Bio: Dr. Schneider has more than 25 years' experience in respiratory and internal medicine, and developed several diagnostic and therapeutic inventions for managing patients with sleep apnea and chronic obstructive lung disease (COPD). The most recent inventions include a disposable pneumotachometer and a device delivering warm and humidified air through a nasal cannula. His current research focusses on developing methods that protect the lungs during sleep to prevent disease progression in patients COPD and cystic fibrosis.

J.   **Anna Maria Bianchi, Ph.D.** Department of Electronics, Information and Bioengineering, Politecnico di Milano, Italy. annamaria.bianchi@polimi.it

Title of presentation: Time-varying changes in cardiovascular variability in sleep apnea

Bio: Dr. Bianchi is Associate Professor of Biomedical Engineering at the Politecnico di Milano. She is a member of EMBS and Associate Editor of the IEEE Transactions on Biomedical Engineering. Her main research interests revolve around the development of parametric models for the description and interpretation of the signals related to the cardiovascular and the neurosensory systems.

K. **Beena Ahmed, Ph.D.** Texas A&M University at Qatar, Doha, Qatar.
beena.ahmed@qatar.tamu.edu

Title of presentation: An automated system to assist clinicians in the detection of insomnia using minimally invasive sensors

Bio: Beena Ahmed is a faculty member at Texas A&M University at Qatar. She studied electrical engineering at the University of New South Wales in Sydney, Australia. Her research interests focus on the application of engineering in healthcare, specifically using sensors, technology, signal processing and pattern classification to develop systems to better monitor and diagnose sleep, stress and speech disorders.

L. **Nicos Maglavera**, Ph.D. Laboratory of Medical Informatics, Aristotle University of Thessaloniki. nicmag@med.auth.gr

Title of presentation: OSAS diagnostics related to heart/lung sounds and SPO2

Bio: Dr. Maglavera is Professor and Director of the Laboratory of Medical Informatics at A.U.Th. He is head of the graduate program in medical informatics at A.U.Th, as well as a collaborating researcher with the Center of Research and Technology Hellas, the Institute of Applied Biosciences (CERTH-INAB). His current research interests include nonlinear biological systems simulation, cardiovascular engineering, biomedical informatics, ehealth, AAL, personalised health, biosignal analysis, medical imaging, CDSS and neurosciences.

Organizer I: **Michael C.K. Khoo, Ph.D.**

Bio: Dr. Khoo is Professor of Biomedical Engineering and Pediatrics at the University of Southern California (USC). He is an IEEE Fellow and Vice-President for Conferences in EMBS. He was conference chair for EMBC 2012, and previously, chair of the EMBS Cardiopulmonary Systems Technical Committee. Dr. Khoo's main research interests include modeling of cardiorespiratory and metabolic control in sleep disorders, autonomic control in sickle cell disease, biomedical signal processing, and noninvasive patient monitoring.

Organizer II: **Thomas Penzel, Ph.D.**

Bio: Dr. Penzel is a physicist and physiologist. He studies sleep in healthy subjects and patients with sleep disorders, with a focus on cardiovascular regulation. He has analyzed heart rate variability and blood pressure variability in these subjects. Currently he works at the sleep medicine center in Berlin, Germany as a research director for sleep research on cardiovascular consequences of insomnia and educates medical and engineering students. He is a Senior Member of EMBS and the current chair of the Cardiopulmonary Systems Technical Committee

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Title: Advances in brain connectivity analysis: perspectives and pitfalls

Abstract: Brain connectivity is a central concept to understand brain functional organization. The description of correlation/causality existing between brain activations during specific asks, or even at rest, can provide important insights into the neural mechanisms at the basis of motor and cognitive functions, their modifications resulting from different pathological conditions and their reorganization consequent to a specific treatment or to spontaneous recovery. Through the participation of some of the scientists that mostly contributed to the development of this field, this Minisymposium addresses the study of brain connectivity from different perspectives, including the critical discussion of some controversial issues related to the subject, new methodological

advancements and a perspective on future directions of this research. We will show how the results obtained using different concepts and inference methods compare when analyzing the same real-world brain electrical activity dataset (Sameshima). We will then focus on Granger causality, to explore some of the most debated controversies related to its use. A study introducing a state-space modeling framework will investigate the effects of volume conduction on the evaluation of causal connectivity (Faes). The application of Granger causality to functional magnetic resonance imaging (fMRI) and the related concerns regarding the neural interpretability of the results will be addressed by showing evidence supporting the viability of its use (Ding). The problem of nonlinearity of the brain interactions will be discussed, examining examples of the effectiveness of kernel mapping applied to the estimation of nonlinearly connected signals for specific extension of Granger-based estimators (Baccalà). Convergent Cross Mapping, an approach defining interactions between time series in terms of nonlinear stability, will be applied to the investigation of nonlinear interactions within the EEG in epilepsy (Schiecke). Finally, the use of simultaneous recordings acquired from multiple subjects to build a connectivity model of social cognitive functions will be discussed (Astolfi).

LIST of Speakers

A. **Koichi Sameshima**, University of Sao Paulo, Brazil, ksameshi@usp.br

Title of the presentation: Brain network dynamics characterization in epileptic seizures through diverse connectivity inference and analysis methods

Bio: BS in EE, M.D. and Ph.D. from University of Sao Paulo, and postdoctoral training at University of California San Francisco on learning and plasticity with electrophysiological and behavioral protocols in animal models. His research interests are focused on neural information processing, plasticity and cognitive function in mammal brains. He has been working on frequency domain multivariate connectivity in the past decade. Right now he is involved in translational research in neurological diseases through the analyses of brain activity signals seeking to bring the benefits of connectivity analysis methods to the clinical domain.

B. **Luca Faes**, Bruno Kessler Foundation, Trento, Italy, faes.luca@gmail.com

Title of the presentation: Evaluation of Granger causality for scalp EEG signals: the effects of volume conduction

Bio: Luca Faes (M'07) received the MS degree in Electronic Engineering from the University of Padova, Italy, in 1998, and the PhD degree in Electronic Devices from the University of Trento, Italy, in 2003. He is currently with the Bruno Kessler Foundation and the Interdepartmental Center for Biotechnologies (BIOtech) of the University of Trento. His research interests include time series analysis and system modeling applied to cardiovascular neuroscience, network physiology, and brain connectivity. Within these fields, he authored five book chapters and more than 120 journal publications, receiving more than 1600 citations. His H-index is 24.

C. **Mingzhou Ding**, University of Florida, United States, mding@bme.ufl.edu

Title of the presentation: Is Granger causality a viable technique for analyzing fMRI data

Bio: Mingzhou Ding received his BS degree in astrophysics from Peking University in 1982 and his PhD degree in physics from University of Maryland in 1990. He is currently the J Crayton Pruitt Family Professor of Biomedical Engineering at University of Florida. Prof. Ding's research focuses on multivariate signal processing, multimodal neuroimaging, cognitive neuroscience, and cognitive impairments in neurological and psychiatric disorders. He is known for developing causal functional connectivity measures and applying these

measures to multimodal neural data. Prof. Ding is an elected fellow of AIMBE, a senior member of IEEE, and serves on the editorial board of Scientific Reports and Journal of Neuroscience. He has published 150 papers and these papers have received 12,000 Google Scholar Citations (H-index=60).

D. Luiz A. Baccalá, *University of São Paulo, Brazil,* baccala@lcs.poli.usp.br

Title of the presentation: Capturing nonlinear connectivity via kernel mapping: issues and performance

Bio: After majoring in Electrical Engineering and Physics at the University of São Paulo ('84) Luiz Baccalà went on to obtain his M. Sc. from the same University ('91). He has since been involved in statistical signal processing and analysis and obtained his Ph. D. from the University of Pennsylvania ('95) by proposing new statistical methods of communication channel identification and equalisation. His current research interests focus at the investigation of multivariate time series methods for neural connectivity inference and for problems of inverse source determination using arrays of sensors that include fMRI imaging and multi electrode EEG processing.

E. Karin Schiecke, Friedrich Schiller University Jena, Germany, karin.schiecke@med.uni-jena.de

Title of the presentation: Directed Interactions Within EEG Activity in Children with Temporal Lobe Epilepsy: Benefits and Limitations of Advanced Time-Variant, Nonlinear Approaches

Bio: Karin Schiecke (M'14) received the Diploma degree in mathematics from the Friedrich Schiller University Jena, Germany, in 1993, and the Ph.D. degree in biomedical engineering from the Technical University Ilmenau, Germany, in 2008. Since 1998 she has been with the Jena University Hospital, Friedrich Schiller University. She is a Senior Research Fellow and member of the Bernstein Group for Computational Neuroscience Jena. In the main focus of her research are time-variant and nonlinear methods to quantify complex dynamical behavior of biomedical systems. From 2016 she is the person in charge of 'Workshop Activities' within the IEEE EMBS Technical Committee on Biomedical Signal Processing.

F. Laura Astolfi, *University of Rome Sapienza, Italy,* laura.astolfi@uniroma1.it

Title of the presentation: Estimation of multiple subjects connectivity for studying social cognitive functions

Bio: Laura Astolfi (MS in Electronics Engineering, University of Rome Sapienza, PhD in Biomedical Engineering. University of Bologna) is currently an Assistant Professor at the University of Rome Sapienza and a Technical Manager at Fondazione Santa Lucia IRCCS. She is Chair of the IEEE EMBS Biomedical Signal Processing
Technical Committee and Editor of the EMBC since 2010. Her research interests include brain functional connectivity estimation, high resolution EEG source reconstruction, multimodal integration of EEG and fMRI data, hyperscanning, consciousness, cognition and social Neuroscience. She authored 195 publications (h-index 29).

Organizer I: Laura Astolfi - IEEE EMBS Member- EMBS TC BSP Chair

Bio: Laura Astolfi (PhD in Biomedical Eng. 2007) is currently an Assistant Professor at University of Rome Sapienza. She is Vice-chair of the EMBS Technical Committee in Biomedical Signal Processing and an IEEE EMBC Associate Editor since 2010. She authored 195 papers published on peer-review international journals. Her h-index is 29.

Organizer II: **Luca Faes –** IEEE EMBS Member –EMBS TC BSP Member

Bio: Luca Faes (M'07) is currently senior researcher at the Bruno Kessler Foundation, Trento, Italy. Since 2007 he has been IEEE EMBC Associate Editor. He authored more than 120 papers published on peer-review international journals, receiving more than 1600 citations. His H-index is 24.

Title: From Pathogens to Cell Therapy: Latest Advances in Biosensor Fabrication, Characterization, and Applications

Abstract: The recent news of the Zika virus infection and re-occurring foodborne outbreaks (*e.g.,* e-coli, salmonella, listeria, *etc*.) represent an increasing need for awareness and response (via biomedical sensors) to such illness and its impact to the well-being of a vibrant society. This mini-symposium will focus on recent developments in the fabrication and characterization of different types of biomedical sensors with a particular focus on pathogen and cell-based biomarkers. All the presentations in this mini-symposium are driven by application oriented research activities that range from pure "academic" research to actual "real-world" field testing. Professor Sushanta Mitra will give an overall survey on fabrication strategies in designing biosensors that cover the important aspects in optimizing and understanding the end-use need and requirements. For example, there is a growing demand to find facile and inexpensive methods to fabricate disposable (single-use) biosensors for environmental and health monitoring. Professor Chenzhong Li will discuss the present challenges and prospects for using cell-based biosensors for "theranostics" – combining diagnostics with therapy applications. There is a rapidly growing interest in such lab-on-achip technology for high-throughput screening and diagnostics with a clearly defined need to conduct these measurements on ultra-small sample volumes, if possible. Finally, Professor Thomas Thundat will round out the minisymposium with a prospective of alternative biomarker/biosensor strategy that involves ultralow level detection. This mini-symposium is intended to be high interactive; hence, the small number of invited talks to ensure lengthy discussions among the participants.

List of Speakers

A. **Sushanta K. Mitra,** York University, mitras@yorku.ca

Title of presentation: Micro & Nano-fabrication for Biosensors

Bio: Professor Sushanta K. Mitra is the Associate Vice-President Research at the York University and the Kaneff Professor in Micro & Nanotechnology for Social Innovation. Prior to this, he was the Chair of the Mechanical Engineering Department at the Lassonde School of Engineering, York University. He is also the Director of Micro and Nano-scale Transport (MNT) Lab. Prof. Mitra's research interests are primarily in the area of fundamental understanding of fluid transport mechanisms in micro and nano-scale confinements, which are relevant to condensed matter physics. His research applications tackle some of the world's most challenging problems, including the development of tools and techniques for efficiently extracting oil and gas from reservoir rocks, bio-converting coal into methane (bio-energy pathways), increasing water monitoring efficiency and affordability (environment monitoring), and detecting vector borne, bacterial and cardiac diseases (health applications).

B. **Chenzhong Li,** Florida International University*,* licz@fiu.edu

Title of presentation: Cell on Chips for Theranostics

Bio*:* Prof. Chenzhong Li is an Associate Professor in the Biomedical Engineering Department at Florida International University and Principle Investigator of Nanobioengineering/Bioelectronics Lab at the Motorola Nanofabrication Center of Advanced Materials Engineering Research Institute. Prof. Li's research group interfaces with biomedical engineering, nanobiotechnology, electrochemistry, BioMEMS, biochemistry, nanomedicine, surface science, and materials science to develop next generation of biosensors, Lab-on-Chip, micro/nano electrodes as well as end use of such biomedical devices for neuron mapping, clinical diagnosis, Point of Care Testings (POCTs), drug screening/delivery, non-invasive therapy, and other environmental applications.

C. **Thomas Thundat,** University of Alberta*,* Email: thundat@ualberta.ca

Title of presentation: Nanomechanical Infrared and Mass Spectroscopy of Biomolecules

Bio: Prof. Thomas Thundat is the Canada Excellence Research Chair in Oil Sands Molecular Engineering at the University of Alberta. Prior to this, he served as corporate fellow and leader of the Nanoscale Science & Devices Group at the Oak Ridge National Laboratory as well as being a research professor at the University of Tennessee, Knoxville. Prof. Thundat is a world leader in the study of molecules and nanoscale structures at interfaces. He has pioneered new techniques for detecting molecules on surfaces and has developed new sensors that have tremendous potential applications for biomedical applications, in particular toward detecting extremely small concentrations of biomarker molecules.

Organizer I: **Larry Nagahara**

Bio: Larry Nagahara is Associate Dean for Research at the Whiting School of Engineering, Johns Hopkins University as well as Research Professor in the Department of Chemical and Biomolecular Engineering. Previously, he served as Associate Director in the Division of Cancer Biology at the NCI/NIH and oversaw their physical sciences-oncology initiative. Larry Nagahara is an IEEE EMBS Fellow and a former EMBS Distinguished Lecturer (2014-2015). In addition, he served as the EMBS representative on the IEEE Nanotechnology Council (2011-2014).

Title: **Career Development – Publishing, Partnerships, Professional Networking and Pathways to Commercialization**

Abstract: As a scientist or engineer, your discoveries and inventions often speak for themselves. But sometimes your work and your career can benefit from wider recognition garnered through publishing, partnerships and personal networking. Your discoveries and inventions may also be worthy of commercialization – but how do you get from the lab to deployment? This session will offer insights on how, when, and where to publish, tips for writing compelling papers, tools for reviewing (and being reviewed), and opportunities to advance your career through participation on editorial boards. The session will also underscore the importance of cross-institute/cross-specialty collaborations. Speakers will provide actionable tools for creating collaborations within and beyond your organization as well as tips on growing the quality and quantity of your personal professional network. We will address opportunities for commercialization and how to get started from tech transfer and discover through early financing opportunities. Finally, we will cover career paths that span academia, public agencies, and industry and how to transition from one to another. The session will close with a panel discussion and Q&A.

List of Speakers

A. **Margot Puerta** – Executive Editor, Feinstein Institute Press, mpuerta@northwell.edu

Bio: Margot Puerta is a recovering scientist who has spent the past thirteen years in biomedical publishing. She is the executive editor of two open access, international journals: Molecular Medicine and Bioelectronic Medicine. Under Ms. Puerta's management, Molecular Medicine has earned an impact factor of 4.508; Bioelectronic Medicine launched in late 2014 and is pending application for indexing. Ms. Puerta develops and implements strategic planning for all forms of media communication regarding the journals. She works in collaboration with scientific and academic editors to attract and identify high-quality manuscripts in the diverse fields covered by the journals.

B. **Jo Ann Platt** – President, Platt & Associates, Inc.*, jojoplatt@theplattassociates.com

Title of presentation: Enhancing Your Career Through Collaborations and Networking

Bio: Jo Ann (Jo Jo) Platt is a strategic relations consultant working with medical research leaders to advance the field of Bioelectronic Medicine. She uses her network and partnership development tools to bring together the communities of biomedical engineering, neuroscience and neurotechnology, and molecular medicine to advance science and deploy new biomedical technologies. Ms. Platt helps organizations to attract new talent, fill resource and/or knowledge gaps through collaboration and to identify and launch commercial spin-off opportunities.

C. **Christopher J. Czura**, Ph.D. – Vice President, Scientific Affairs, Feinstein Institute for Medical Research, cczura@northwell.edu

Title of presentation: From Back-of-the-Napkin to Spin-Off

Bio: Christopher Czura is vice president of the Feinstein Institute for Medical Research, executive publisher of the Feinstein Institute Press' international, peer-reviewed journals *Molecular Medicine* and *Bioelectronic Medicine*, and executive producer of the Merinoff Conference Series. Dr. Czura provides oversight of the Feinstein Institute's daily operations and $95 million annual budget. A molecular biologist by training, Dr. Czura collaborates with the president to develop and execute strategic plans for the Feinstein Institute, and provides leadership in building successful programs that nurture the collaborative and interactive environment of the Feinstein Institute.

D. **Imran Eba** – Partner, Action Potential Venture Capital – GSK's Bioelectronic Medicines Innovation Fund*, Imran.a.eba@actionpotentialvc.com

Title of presentation: Off the Bench and on to the Bank

Bio: Imran Eba is a partner at Action Potential Venture Capital in Cambridge, Massachusetts. He invests in companies that are pioneering bioelectronic medicines and technologies. Mr. Eba represents Action Potential Ventures as a board member or observer on the boards of Axon Therapies and SetPoint Medical.

E. **Kip Ludwig, Ph.D.** – Associate Director, Neural Engineering Lab, Mayo Clinic, ludwi1ka@hotmail.com

Title of presentation: Career Transitions – From Academia to Industry to Public Agency and Back Again

Bio: Kip Ludwig has three primary roles at the Mayo: associate director of the Mayo Neural Engineering Laboratories, vice-chair of the Enterprise Neurosurgery Research Program (appointment pending), and independent investigator charged with developing a world-class research program in the area of neuromodulation therapies for end-organ systems. Dr. Ludwig earned his Ph.D. and did his postdoc work at the University of Michigan. From there he

served as a senior research scientist at CVRx, program director for neural engineering at NIH, and is now with the Mayo. * 2014 Journal Citation Report ⚓

Organizer I: **Jo Ann Platt** -EMBS Member

Bio: Jo Ann (Jo Jo) Platt is a strategic relations consultant working with medical research leaders to advance the field of Bioelectronic Medicine. She uses her network and partnership development tools to bring together the communities of biomedical engineering, neuroscience and neurotechnology, and molecular medicine to advance science and deploy new biomedical technologies.

Organizer II: **Margot Puerta -**EMBS Member

Bio: Margot Puerta is a recovering scientist who has spent the past thirteen years in biomedical publishing. She is the executive editor of two open-access, international journals: Molecular Medicine and Bioelectronic Medicine. Under her management, Molecular Medicine has earned an impact factor of 4.508*; Bioelectronic Medicine launched in late 2014 and is pending application for indexing.

Title: **Integrating Image-Guided Therapeutic Systems and Computer-Assisted Intervention Platforms**

Abstract: Given the reduced size of the incision and limited exposure of organs and tissues, minimally invasive interventions rely on medical imaging for visualization, guidance and navigation during therapy delivery, as a means to compensate for the lack of traditional direct vision. Controlled image-guided energy delivery via non-invasive and minimally invasive approaches has emerged as a means for augmenting the efficacy of other therapeutic modalities (e.g. chemo/radiotherapy), in situ tissue ablation, and localized delivery of therapeutic agents. To achieve the necessary visualization, mixed reality medical imaging environments aim to provide the physician with enhanced perception of the patient either by fusing various imaging modalities with surgical tracking and navigation information, establishing a direct relation between images and patient and often presenting image-derived information overlaid on the physician's view for intuitive guidance.

List of Speakers:

A. Dieter Haemmerich, PhD, Medical University of South Carolina

Bio: Dieter Haemmerich, PhD*,* is a Professor of Pediatrics at the Medical University of South Carolina, and Adjunct Faculty of Bioengineering at Clemson University. He is senior member of IEEE-EMBS, a Fellow of the Heart Rhythm Society (HRS), past President of the Society for Thermal Medicine (STM), and past chair of the EMBS Technical Committee on Therapeutic Systems and Technologies (http://tctherapeutic-systems.embs.org/). Dr. Haemmerich has served as Theme Chair, Track Chair, and Conference Editor of the annual IEEE-EMBC. His research interests include thermal ablation, biomedical instrumentation, measurement of thermal and dielectric tissue properties, and computational modeling of biological heat transfer problems and targeted drug delivery (see ablation.musc.edu). He has authored ~90 peer reviewed papers, 5 book chapters, and 6 patents. He has served on the editorial board of more than 50 scientific journals and is member of the NIH study section on Radiation Therapy and Biology. Dr. Haemmerich's presentation will focus on technology and techniques for image- and navigation-guided RF ablation, with applications to different organs and systems.

B. Michael I. Miga, PhD, Vanderbilt University

Bio: Dr. Miga began his appointment to the faculty at Vanderbilt University in the Spring of 2001 and is currently the Harvie Branscomb Professor, and a Professor of Biomedical Engineering, Radiology and Radiological Sciences, and Neurological Surgery. He is director of the Biomedical Modeling Laboratory, and co-founder of the Vanderbilt Institute in Surgery and Engineering Center (VISE). He has been awarded multiple NIH grants concerned with image-guided brain and liver surgery, as well as robotic devices for intracranial hemorrhage removal. He recently served 4 years as a charter member of the Biomedical Imaging Technology Study Section at NIH. In May of 2014, Dr. Miga was inducted into the American Institute for Medical and Biological Engineering College of Fellows representing the top 2% of medical and biological engineers. His research interests are in image-guided surgery, computational modeling for therapeutic applications, and inverse problems in therapeutics and imaging.

Dr. Miga's presentation will focus on the translation of computational biophysical models from predictive roles to ones that are more integrated within therapeutic and novel imaging/image-guided frameworks. Model-embedded systems designed to enable novel integration of soft-tissue imaging data within surgical applications will be presented as excellent example toward these paradigm-shifting efforts.

C. **Dorin Panescu, PhD,** Advanced Cardiac Therapeutics

Bio*:* Dr. Dorin Panescu is the Vice President, Systems Engineering and IP Strategy, with Advanced Cardiac Therapeutics, Inc. in Santa Clara, CA. Dr. Panescu is inventor on over 155 issued US patents, and on over 100 issued international patents. He has co-authored over 150 technical publications. Dr. Panescu is a Fellow of the IEEE. Dr. Panescu's presentation covers aspects related to image- and navigation-guided RF ablation of atrial fibrillation (AFIB). AFIB treatment may be improved by ablating using open-irrigated temperature-controlled RF energy applied at anatomic locations, which can be "visualized" using imaging and navigation technologies.

Organizer I: **Cristian A. Linte***, Member, EMBS*

Bio*:* Cristian A. Linte is an Assistant Professor in Biomedical Engineering and Chester F. Carlson Center for Imaging Science at Rochester Institute of Technology. His research interests span the development of tools and techniques for image processing, modeling and visualization for surgical planning and interventional guidance, as well virtual and augmented anatomy visualization paradigms for simulation, teaching and training. Dr. Linte leads the Biomedical Modeling, Visualization and Image-guided Navigation laboratory at Rochester Institute of Technology, where he is a faculty member in Biomedical Engineering and the Chester F. Carlson Center for Imaging Science. His presentation will provide a tour de force overview of the history, current status and state-of-the-art, lessons learned and future directions in the field of image-guided cardiac interventions, with a significant emphasis on the challenges that need to be overcome to promote and facilitate the adoption of minimally invasive computer-assisted intervention techniques for cardiac applications.

Organizer II: **Punit Prakash***, Member, EMBS*

Bio: Punit Prakash is an Assistant Professor in the Department of Electrical and Computer Engineering at Kansas State University. His research efforts are focused on integrating computer modeling and medical instrumentation to develop therapeutic medical devices for precise, image-guided thermal therapy of cancer and other human/animal diseases. Dr. Prakash leads the Biomedical Computing and Devices Lab is part of the Department of Electrical and Computer Engineering at Kansas State University. His presentation will be focused on developing

technologies for precise, imageguided thermal therapy of cancer and other human/animal diseases. Thermal therapy refers to the use of elevated or severely reduced temperatures for treatment of disease. Therapeutic heating may be achieved by depositing various forms of energy within the body, including microwaves, radiofrequency currents, ultrasound, and lasers. His research focused on applications of electromagnetic and acoustic energy for hyperthermia and thermal ablation including novel devices and techniques for precise delivery of thermal therapy, multi-scale mathematical modeling of thermal therapy bioeffects, characterizing nanomaterial contrast agents for enhancing local deposition of energy, and patient-specific treatment planning tools for guiding clinical procedures.

Title: **Imaging in Biopharmaceutical Industry**

Abstract: The biopharmaceutical industry is increasingly using imaging in all stages of rug development to understand disease processes, assess therapeutic effects, and identify and validate biomarkers of drug efficacy and/or safety. Imaging modalities range from histology to microscopy, magnetic resonance imaging (MRI), computed tomography (CT), etc., can visualize a variety of tissues or organ characteristics that may be modulated by disease progression and/or therapy, and can provide valuable data supporting internal Go/No Go decisions to accelerate the development of the most promising compounds. With the recent advances in molecular imaging techniques, imaging can also study biodistribution and pharmacokinetics of drugs to facilitate the acceleration of new drug therapies. Moreover, imaging enables development of predictive biomarkers for patient stratification to determine the which group of patients will respond to therapy. Through the use of in vivo imaging techniques, the development of translatable biomarkers from preclinical to clinical phases of drug development will further reduce drug development costs and increase the probability of success in clinical trials. This proposed special session will share the current progress in the imaging field, associated imaging techniques, and how these techniques are being utilized in various stages of drug development through extended discussions. This session will bring researchers from both industry and academia to increase awareness in how imaging is being used during drug development and leverage collaboration opportunities. We expect healthcare researchers working in various imaging technologies to attend to this session.

List of Speakers

    A. **Catherine Diane Gard Hines**, Director, Translational Imaging Biomarkers, Merck, catherine.hines@merck.com

    Title of the presentation: Imaging in Drug Development and Safety Assessment

    Bio: Catherine received her B.S. in Biochemistry from Iowa State University and her master's and Ph.D. degrees in Biomedical Engineering from the University of Wisconsin-Madison. In her current role at Merck, she leads the West Point, PA MRI, CT, US and Optical Imaging team to support preclinical drug discovery and development, and develop new biomarkers. Her current MRI projects include designing and developing MRI protocols and workflows in small and large animals in diabetes and endocrinology, cardiovascular, infectious diseases, safety assessment, neuroscience, and oncology applications.

    B. **Hasan Alsaid**, Senior Scientific Investigator, BioImaging, GlaxoSmithKline, hasan.5.alsaid@gsk.com

    Title of the presentation: Drug Biodistribution Using Preclinical and Translational Imaging

Bio: Hasan has a PhD in Biomedical Engineering from Université Lyon 1, France. He joined GlaxoSmithKline R&D in 2008 as a postdoc fellowship and currently holds a Senior Scientific Investigator position. He has co-authored many scientific papers in cardiovascular, respiratory, and oncology research.

C. **Sarah Sherlock**, Associate Director, Imaging & Engineering, Pfizer, Sarah.Sherlock@pfizer.com

Title of the presentation: Imaging Biomarkers in Neuromuscular Diseases

Bio: Sarah Sherlock is an Associate Director in the Imaging and Engineering Group at Pfizer based in Cambridge, MA. Sarah specializes in incorporating imaging biomarkers into clinical development plans with a focus on musculoskeletal and inflammatory diseases. Prior to joining Pfizer, she worked at Parexel Informatics executing MRI, CT, x-ray, optical and DXA based studies. Sarah has a B.A. in Chemistry from New College of Florida and a Ph.D. in Chemistry from Stanford University.

D. **Thomas Nifong**, Executive Vice President of Predictive Tests at Definiens, The Tissue Phenomics Company, tnifong@definiens.com

Title of the presentation: Utilizing Tissue Phenomics in Predictive Medicine

Bio: Dr. Nifong joined Definiens in 2014. He brings more than 15 years of experience in clinical diagnostics development and operations, laboratory medicine, and project engineering. Prior to joining Definiens, Dr. Nifong was Senior Vice President of Clinical Operations for Metamark Genetics, where he successfully led efforts to translate quantitative multiplex immunofluorescence research protocols into robust, reproducible laboratory developed tests (LDTs) for clinical use. He spent 10 years as a faculty member at the Penn State Hershey Medical Center where he gained extensive experience in molecular pathology, clinical laboratory medicine, and laboratory validation and management. In his role as Executive Vice President of Predictic Tests, Dr. Nifong is responsible for regulated product development and commercialization for all clinical diagnostic projects incorporating Definiens technology. Dr. Nifong holds a BS in Chemical Engineering from Purdue University and an MD from the University of Rochester. He completed his residency training in Clinical Pathology and is a Diplomat of the American Board of Pathology and a Fellow of the American Society for Clinical Pathology and the College of American Pathologists.

Organizer I: **Belma Dogdas,** Associate Principal Scientist, Applied Mathematics and Modeling, Merck

Bio: Belma Dogdas is an Associate Principal Scientist in Applied Mathematics and Modeling group at Merck, NJ, USA. She leads the Image Data Analytics program and her research involves development of mathematical and computational algorithms for multi-dimensional analysis of relevant biological imaging applications. Prior to joining Merck, Dr. Dogdas received MS and PhD degrees from University of Southern California, Electrical Engineering Department in 2002 and 2007 respectively. She is a member of the IEEE Engineering in Medicine and Biology Society.

Title: **Biomedical Engineering Challenges of the Next Century**

Abstract: The Mini-symposia session titled: "Biomedical Engineering Challenges of the next century" is an overview of the world´s education status in Biomedical Engineering given by leading researchers covering a specialized topic in multi-disciplinary and cross-disciplinary areas of biomedical education, and the new experiences and areas of interest in their regions (Europe, USA, Asia and

Latin America). The globalization and the new ITs must be used to improve the education in this field in order to solve health problems focus in social impact. In a world of growing incidence of chronic disease and ageing population, there is a constant need for innovation in biomedical engineering field; this means that the curricula must be adapted to the expectations of the future professionals in regards to the constant need for innovation in health care technologies and areas such as clinical engineering.

List of Speakers:

A. Prof. dr. sc. Ratko Magjarevic, University of Zagreb Faculty of Electrical Engineering and Computing

Title of the presentation: Challenges of Biomedical Engineering Education

Bio: Ratko Magjarević received his Ph.D. in Electrical Engineering in 1994 from the University of Zagreb, Faculty of Electrical Engineering. After his appointment in industry at the Institute of Electrical Engineering "Koncar," he joined the Electronic Measurement and Biomedical Engineering Group at the University of Zagreb Faculty of Electrical Engineering and Computing. He is full professor teaching several courses in Electronic Instrumentation and Biomedical Engineering at undergraduate, graduate and at postgraduate studies. As visiting professor he was teaching at Universities in Dubrovnik, Rijeka, Stuttgart, Trieste, Ljubljana, Madrid and Bogota. His scientific and professional interest is in fields of electronic and biomedical instrumentation, in particular in bioelectric potential analysis and in cardiac pacing, computer modelling of biological systems, in research of new methods for drug delivery based on electropermeabilisation and recently in research in biomedical and health informatics, in particular in research of personalised intelligent health systems and body area networks. R. Magjarević is author of more than 80 publications including edited books, textbooks, book chapters, journal articles and conference papers. He was principle investigator and/or took part in more than 20 of research projects financed by by the EC and by the Ministry of Science, Education and Sports of the Republic of Croatia as well as in a number of bilateral international projects. He also collaborates with companies and industry in Croatia. He serves as a reviewer for international journals and major international conferences. R. Magjarevic was serving as the President of International Federation for Medical and Biological Engineering (IFMBE) for the term of office 2012-15. He is also the Editor in Chief of the IFMBE Proceedings series published by Springer.

B.   Prof. Herbert F. Voigt, Ph.D., Professor, Biomedical Engineering Boston University
Fulbright Scholar, 2014-2015 Past-President, International Union for Physical &
Engineering Sciences in Medicine (IUPESM) Past-President, International Federation for
Medical & Biological Engineering (IFMBE)

Title of the presentation: Clinical Engineering in the United States: Time to embrace an undergraduate program

Bio: Professor Voigt, a Boston University biomedical engineering professor, is a 2014/2015 Fulbright Scholar working with Peru. He is Past-President (2015-2018) of the International Union for Physical and Engineering Sciences in Medicine (IUPESM), which is a member Union of the International Council of Sciences (ICSU). He was President of the International Federation for Medical and Biological Engineering (IFMBE, 2009-2012) and President of the American Institute for Medical and Biological Engineering (AIMBE, 2006-2007), the Biomedical Engineering Society (BMES, 1999) and Alpha Eta Mu Beta (the National Biomedical Engineering Honor Society, 2002-2008). Voigt received his B.E. in electrical engineering from the City College of New York (CCNY) in 1974 and his Ph.D. in biomedical engineering from the Johns Hopkins University in 1979. He has been an IEEE member 1974, currently an IEEE/EMBS Senior Member. He received an Alumni Career Achievement Award from CCNY in 1994 and was elected to the Johns Hopkins Society of Scholars in

2003. He received the Biomedical Engineering Society's President's Award (2002) and it's Distinguished Service Award (2004). He is a BMES Founding Fellow (2004) and an AIMBE Fellow (1998). He was designated an IEEE/EMBS Distinguished Lecturer for 2012- 2013 and was elected an honorary member of the Swedish Society of Medical Engineering and Physics (2012). His research interests include understanding the neural circuitry of the cochlear nucleus; heavy metal detection in biological samples and Global Health and Development.

C. **Prof Kang-Ping Lin** Director of Technology Translation Center for Medical Devices at Chung-Yuan, Christian University, Taiwan

Title of the presentation: Web-based Experience Sharing System for Clinical Engineering

Bio: Professor Kang-Ping Lin is Distinguished Professor for Electrical Engineering and the Director of Technology Translation Center for Medical Devices at Chung-Yuan Christian University, Taiwan. He received his BS and MS degrees in Biomedical Engineering and Applied Physics from the Chung-Yuan Christian University, Taiwan in 1982 and 1984, respectively. In 1994, he earned his Ph.D. degree in Biomedical Physics, School of Medicine UCLA. He served as Director of Medical Device Technology Division of the Biomedical Engineering Center in Industrial Technology Research Institute in Taiwan (2000~2004). From 2004 to 2011, he was the CEO of Daily Care Biomedical Inc. (DCBM) which is a start-up medical device company established in 2004. The company has 24 employees included 12 biomedical engineers for developing innovative handheld ECGs and its applications. One of the DCBM's product developed by Dr. Lin earned the annual Excellent Product Award in 2006 in Taiwan. He was the president of Taiwanese Society of Biomedical Engineering (2007~2010), the Editor-in- Chief of the Journal of Medical & Biological Engineering (1999~2007), and the Editor-in-Chief of IFMBE News (2009~2015). He is the AC member of both Chinese Society of Biomedical Engineering (2013-2015) and Taiwanese Society of Molecular Imaging (2009~2015). He has been elected to be the Secretary General of IFMBE (2015~2018). His research interests include handheld medical devices, physiological signal processing, and medical image processing.

D. **Prof. Martha Zequera Díaz,** University of Javeriana Electronics Department Faculty of Engineering

Title of the presentation: A new prospective of Biomedical Engineering Education in Latin America

Bio: Prof. Martha Zequera Ph.D. is Full (Titular) Professor at Electronics Department, School of Engineering, at Pontificia Universidad Javeriana, Bogotá, Colombia and she has been working as a researcher for 15 years at the Bioengineering Research Group "BASPI", focus in Biomedical Engineering research including biosensors, biomedical instrumentation, medical devices and e-health in rehabilitation, biomechanics instrumentation, biomechanical especially for Diabetes care research. She has been is the Latin American Representative of the Engineering in Medicine and Biology Society IEEE/EMBS since 2010 until 2014, she is also AdCom member of the International IEEE/EMBS and she was nominated as a Chair of the IEEE/EMBS Chapter World Development Committee during 2010, 2011 and 2012. Dr. Zequera was also the Scientific Secretary of the Latin American Regional Council on Biomedical Engineering (CORAL) for five years, from 2005 to 2010. Dr. Zequera was Vice Chair of the Biomedical Engineering National Societies Committee of the European International Federation for Medical and Biological Engineering (IFMBE). She has been promoting Biomedical Engineering Education and Curriculum – novel approaches to BME for global education

E. **Prof Shankar Krishnan, Ph. D**. Vice President, IFMBE Professor and Chair
Department of BME
WIT, Boston, MA

Title of the presentation: Effective Roles of Industry Professionals in Academic BME Programs: A Global Perspective

Bio: Dr. Shankar Krishnan is the founding chair of the Biomedical Engineering program and an endowed chair Professor at Wentworth Institute in Boston since 2008. He received his Ph.D. degree from the University of Rhode Island with research work done at Rhode Island Hospital. Previously, he was an assistant director at Massachusetts General Hospital (a teaching affiliate of Harvard Medical School) in Boston. He has also held faculty appointments in Illinois, Miami and Singapore. At NTU in Singapore, he was the founding director of the BME Research Center and the founding head of the Bioengineering division. He was the Principal Investigator for several Biomedical Engineering projects with funding over USD 15 million. He also worked in R&D in Miami and in hospital design and operations management for healthcare megaprojects. He has served in the National Medical Research Council in Singapore. His research interests are BME education, medical robotics, telemedicine, and healthcare analytics. He has about three hundred publications in conference proceedings, book chapters, and journal papers. He keeps active memberships in IEEE, EMBS, AAMI, BMES, ASEE, ASME, IFMBE, and MassMedic. He has served the administrative council of IFBME for the past ten years, and is currently the Vice President. He was elected as a Fellow of American Institute of Medical and Biological Engineering and he was a member of a team which received the CIMIT Kennedy Innovation Award in Boston.

Organizer I: Martha Lucía Zequera Díaz Ph.D

Bio: Full (Titular) Professor at Electronics Department, School of Engineering, at Pontificia Universidad Javeriana, Bogotá, Colombia and she has been working as a researcher for 15 years at the Bioengineering Research Group "BASPI". She has been is the Latin American Representative of the Engineering in Medicine and Biology Society IEEE/EMBS since 2010 until 2014, she is also AdCom member of the International IEEE/EMBS. Dr. Zequera was also the Scientific Secretary of the Latin American Regional Council on Biomedical Engineering (CORAL). She has been promoting Biomedical Engineering Education and Curriculum – novel approaches to BME for global education

Organizer II: Prof. Ratko Magjarevic

Bio: Received his Ph.D. in Electrical Engineering in 1994 from the University of Zagreb, Faculty of Electrical Engineering. After his appointment in industry at the Institute of Electrical Engineering "Koncar," he joined the Electronic Measurement and Biomedical Engineering Group at the University of Zagreb Faculty of Electrical Engineering and Computing. He is full professor teaching several courses in Electronic Instrumentation and Biomedical Engineering at undergraduate, graduate and at postgraduate studies. As visiting professor he was teaching at Universities in Dubrovnik, Rijeka, Stuttgart, Trieste, Ljubljana, Madrid and Bogota. He serves as a reviewer for international journals and major international conferences. R. Magjarevic was serving as the President of International Federation for Medical and Biological Engineering (IFMBE) for the term of office 2012-15. He is also the Editor in Chief of the IFMBE Proceedings series published by Springer.

Title: **Progress in Bi-directional Neural Interfaces to Restore Lost Sensorimotor Function**

Abstract: Our ultimate understanding of the nervous system as a complex system is reflected in our ability to predict its dynamics in the normal state and eventually control these dynamics in the pathological state. Interest in neural interface technology that provide a direct communication pathway between the nervous system and man-made, computing devices has been surging, primarily due to striking advances in measuring and manipulating neural dynamics at exceedingly high temporal and spatial resolutions, and to characterize the ever changing interplay between the

neural structure and function. These interfaces also offer an unprecedented opportunity to improve our understanding of brain dynamics in a unique behavioral context, and to improve the lifestyle of many neurologically impaired subjects. Over the last decade, significant progress has been made in the development and initial clinical translation of high-performance neural interface technologies. Notably, multiple research groups are now testing these systems in subjects implanted with high-density arrays of penetrating microelectrodes in target regions. Although long-term reliability of these interfaces remains challenging, these studies have demonstrated that these implants are safe and hold great potential to restore, for example, volitional control to people with profound motor disabilities. Equally important, there is a growing awareness of the need to provide artificial sensory feedback to users controlling prosthetic, or natural but impaired, limbs. This minisymposium will highlight recent work aimed at providing efferent control and/or afferent feedback via neural interfaces that target various levels of the sensorimotor system. The symposium will also highlight methods to optimize the stimulation protocol to enable bidirectional exchange of information with the nervous system that will ultimately enable complete motor and sensory integration of the prosthesis into the user's behavioral repertoire.

List of Speakers

A. Karim G. Oweiss, PhD

Title of Presentation: Methods of System Identification for Restoring Lost Sensorimotor Function

Bio: Karim G. Oweiss is a Professor of Electrical and Computer Engineering, Biomedical Engineering at the Herbert Wertheim College of Engineering and a Professor of Neuroscience at the McKnight Brain Institute at the University of Florida. His lab's research interests are in understanding the neural mechanisms of sensorimotor integration and the clinical applications of Neural Interfaces in assisting, augmenting, or repairing damaged human cognitive and sensorimotor functions. Dr. Oweiss received his B.S. (1993) and M.S. (1996) degrees with honors in Electrical Engineering with a minor in bioengineering from the University of Alexandria, Egypt, and the Ph.D. degree (2002) in Electrical Engineering and Computer Science from the University of Michigan (UM), Ann Arbor. Following post-doctoral training in 2002, he was as an assistant (2003-2009) then associate professor (2009-2014) of ECE, Neuroscience and Cognitive Sciences at Michigan State University. Since August 2014, he has been a pre-eminent Professor of Electrical and Computer Engineering, Biomedical Engineering and Neuroscience at the University of Florida. He has published over 170 peer-reviewed articles that span diverse topics ranging from neurobiology of sensorimotor function and dysfunction, computational neuroscience and brain-machine interfaces, to statistical signal processing, information and control theories and circuit design. Dr. Oweiss is a senior member of the IEEE and the Society for Neuroscience. He is an active member of multiple IEEE technical committees on Life Sciences. He was awarded the excellence in Neural Engineering award from the National Science Foundation in 2001. He is the editor and co-author of the book: *Statistical Signal Processing for Neuroscience and Neurotechnology*, published by Academic Press in 2010.

B. Silvestro Micera, PhD

Title of the presentation: Intraneural peripheral stimulation to restore sensory feedback in trans-radial amputees

Bio: Silvestro Micera is currently Professor of Biomedical Engineering at the Scuola Superiore Sant'Anna (SSSA, Pisa, Italy), and Associate Professor of Biomedical Engineering at the Ecole Polytechnique Federale de Lausanne (Lausanne, Switzerland) where he is holding the Bertarelli Foundation Chair in Translational NeuroEngineering. He received the University degree (Laurea) in Electrical Engineering from the University of Pisa, in 1996, and the Ph.D. degree in Biomedical Engineering from the Scuola Superiore Sant'Anna, in 2000. From 2000 to 2009, he has been an Assistant Professor of BioRobotics at the Scuola Superiore Sant'Anna where he is now Professor

and the Head of the Translational Neural Engineering Area. In 2007 he was a Visiting Scientist at the Massachusetts Institute of Technology, Cambridge, USA with a Fulbright Scholarship. From 2008 to 2011 he was the Head of the Neuroprosthesis Control group and an Adjunct Assistant Professor at the Institute for Automation, Swiss Federal Institute of Technology, Zurich, CH. In 2009 he was the recipient of the "Early Career Achievement Award" of the IEEE Engineering in Medicine and Biology Society. From 2011 he is Associate Professor and Head of the Translational Neural Engineering Laboratory at the EPFL. Dr. Micera's research interests include the development of neuroprostheses based on the use of implantable neural interfaces with the central and peripheral nervous systems to restore sensory and motor function in disable persons. In particular, he is currently involved in translational experiments for hand prosthesis control in amputees, and the restoration of vestibular function, grasping and locomotion in different neurological disorders.

C. Dr. Silman Bensmaia, PhD

Title of the presentation: Artificial touch through biomimetic neural microstimulation

Bio: Dr. Sliman Bensmaia received a B.A. in Cognitive Science from the University of Virginia in 1995, and a PhD in Cognitive Psychology from the University of North Carolina at Chapel Hill, in 2003, under the tutelage of Dr. Mark Hollins. He then joined the lab of Dr. Kenneth Johnson, at the Johns Hopkins University Krieger Mind/Brain Institute, as a postdoctoral fellow until 2006, at which time he was promoted to Associate Research Scientist. In 2009, Dr. Bensmaia joined the faculty in the Department of Organismal Biology and Anatomy at the University of Chicago, where he is also also a member of the Committees on Neurobiology and on Computational Neuroscience. The main objective of Bensmaia's laboratory is to discover the neural basis of somatosensory perception using psychophysics, neurophysiology, and computational modeling. Bensmaia also seeks to apply insights from basic science to develop approaches to convey sensory feedback in upper-limb neuroprostheses.

Organizer I: **Karim G. Oweiss,** PhD, Senior member IEEE

Bio: Karim G. Oweiss is a Professor of Electrical and Computer Engineering, Biomedical Engineering at the Herbert Wertheim College of Engineering and a Professor of Neuroscience at the McKnight Brain Institute at the University of Florida. His lab's research interests are in understanding the neural mechanisms of sensorimotor integration and the clinical applications of Neural Interfaces in assisting, augmenting, or repairing damaged human cognitive and sensorimotor functions.

Title: **Emerging Technologies in Bladder Neuroprostheses**

Abstract: Over the past several decades, advances in the field of bladder neuroprostheses has resulted in various clinical therapies that include the Finetech-Brindley system, sacral neuromodulation, and posterior tibial nerve stimulation. The primary goal of this mini-symposium is to provide biomedical engineers with a thought-provoking overview of recent preclinical discoveries and developments. Topics will include new technologies for achieving closed-loop controlled bladder prostheses, innovative strategies for improving the effectiveness of electrical stimulation, and novel stimulation targets for controlling bladder function. Each of these topics have broad utility in the development of neuroprostheses controlling more than just bladder function but also limb position, finger grasp, sensory feedback, and other applications.

List of Speakers

A.   **Dwight Nelson**, Medtronic, dwight.e.nelsen@medtronic.com

Title of presentation: Inspiring evolution in neuromodulation for bladder function

Bio: Dwight Nelson, PhD, is a Chief Scientist in Neuro Global Research at Medtonic, where he has been since 2008. His focus areas include peripheral and spinal neural circuits as targets for therapies and sensing as well as early phase testing and evidence for novel medical applications.

B. **Tim Bruns**, University of Michigan, bruns@umich.edu

Title of presentation: Chronic spinal root interfacing for closed-loop control of the bladder

Bio: Tim Bruns, PhD, is an Assistant Professor of Biomedical Engineering at the University of Michigan and a member of the UM Biointerfaces Institute. His research group, the Peripheral Neural Engineering and Urodynamics Lab, focuses on developing interfaces for restoring function for and examining systems-level neurophysiology of autonomic organs like the bladder.

C. Mohamad Sawan, Polytechnique Montreal, mohamad.sawan@polymtl.ca

Title of presentation: Real-time monitoring of the bladder volume to improve effectiveness of implantable neuroprosthesis

Bio: Mohamad Sawan, PhD, is a Professor of Microelectronics and Biomedical Engineering and Canada Research Chair in Smart Medical Devices at Polytechnique Montreal. He founded and directs the Polystim Neurotechnologies Laboratory, which explores the design and test of mixed-signal circuits and microsystems towards biomedical telecommunication applications.

D. **Paul Yoo**, University of Toronto, paul.yoo@utoronto.ca

Title of presentation: A Novel Approach to Electrically Modulating Bladder Function

Bio: Paul B Yoo, PhD, is an Assistant Professor at the Institute of Biomaterials and Biomedical Engineering (IBBME) at the University of Toronto. Research interests within the field of neural engineering include the development of peripheral nerve interface technologies and the neurophysiological investigation of potential therapeutic mechanisms.

E. **Warren M Grill**, Duke University, warren.grill@duke.edu

Title of presentation: Phasic activation of the urethral sphincter: from understanding to innovative therapy

Bio: Warren Grill, PhD, is a Professor of Biomedical Engineering at Duke University. Dr. Grill's research interests include design and testing of electrodes and stimulation techniques, the electrical properties of tissues and cells, and computational neuroscience, with applications in restoration of bladder function and treatment of movement disorders and chronic pain.

F. **Parag Gad**, University of California Los Angeles, paraggad@gmail.com

Title of presentation: Enabling Bladder Function after Spinal Cord Injury

Bio: Parag Gad, PhD, is an assistant researcher in Dr. V Reggie Edgerton's laboratory within the department of Integrative Biology and Physiology, UCLA. He received his PhD in 2013 focusing on locomotion rehabilitation and improvement in autonomic function using epidural spinal cord stimulation after paralysis.

Organizer I: **Paul B. Yoo**-IEEE & EMBS Member

Bio: Paul B Yoo, PhD, is an Assistant Professor at the Institute of Biomaterials and Biomedical Engineering (IBBME) at the University of Toronto. Research interests within the field of neural engineering include the development of peripheral nerve interface technologies and the neurophysiological investigation of potential therapeutic mechanisms.

Organizer II: **Tim M Bruns –**IEEE & EMBS Member

Bio: Tim Bruns, PhD, is an Assistant Professor of Biomedical Engineering at the University of Michigan and a member of the UM Biointerfaces Institute. His research group, the Peripheral Neural Engineering and Urodynamics Lab, focuses on developing interfaces for restoring function for and examining systems-level neurophysiology of autonomic organs like the bladder.

Title: **Tackling global challenges from Latin America**

Abstract: In Latin America, several institutions are working on global challenges at an advanced level. In this minisymposium, we will address the advantages and challenges of conducting research and developing solutions in Latin America (LA). Areas include biomedical imaging, physiological monitoring, gait analysis, cardiovascular modelling and others. The main advantages include the quality of LA students and engineers and access to advanced engineering tools. This is facilitated by an improved global connectivity and relatively easy access to technology (hardware and software). Our challenges in LA include higher entry barriers to translate research into products due to, among other things, a small biomedical industry size. There are few companies that support research and demand products in general and this poses extra difficulties to collaborate with industry, get funding, show the government of the benefits of a particular development, apply for grants, and achieving a social impact with our innovation projects. We will discuss current projects in LA, future directions and our thoughts on what is needed to foster biomedical engineering solutions with a global impact.

Organizer I: **Esteban J. Pino** – IEEE Senior Member

Bio: Esteban Pino is an associate professor at the University of Concepción, Chile. He is the head of the biomedical engineering program at his institution. He is also the current EMBS AdCom representative for Region 9. His interests include unobtrusive sensing and patient monitoring, and translating research into products that can benefit society.

OrganizerII: **Pablo Irarrazabal –** EMBS Senior Member

Bio: Pablo Irarrazaval is a professor in Electrical Eng. at P. Universidad Catolica de Chile. His research interest includes acquisition and reconstruction of Medical Images, with over 150 peer-reviewed papers. He was the founder of the Biomedical Imaging Center and currently is the Director of newly created Institute of Biological and Medical Engineering at the same University.

Title: **Engineering at the Neural Interface**

List of Speakers

A.   **Jose Carmena**, UC Berkeley, jcarmena@berkeley.edu

   Title of presentation: Recording Brain Activity with Dust

B.   **William Tyler,** Arizona State University, William.Tyler@asu.edu

   Title of presentation: Stimulating Neurons with Ultrasound

C.   **Jonathan Viventi**, Duke University, j.viventi@duke.edu

   Title of presentation: Brain Recording with Flexible Electronics

D. **Dominique Durand**, Case Western Reserve, dxd6@case.edu

Title of presentation: Nerve Recording with Flexible Materials

Organizer I: **Dominique Durand,** Case Western Reserve

Title: **Multiscale Modeling & Simulation: Scientific Impact and Clinical Translation**

Abstract: Symposium presenters will showcase the role of modeling and simulation for discovery of new knowledge, and provide examples of the application of modeling and simulation for healthcare delivery.

List of Speakers:

A.   **Mounya Elhilali, Ph.D., Johns Hopkins University,** mounya@jhu.edu

**Title of presentation*:* Multi scale modeling of brain processes of complex acoustic scenes

Bio: Mounya Elhilali is the Charles Renn faculty scholar and Associate professor of Electrical and Computer Engineering at the department of electrical and computer engineering at the Johns Hopkins University. Her research examines the computational and neural bases of sound and speech perception in complex acoustic environments. Dr. Elhilali is the recipient of the National Science Foundation CAREER award and the Office of Naval Research Young Investigator award.

B.   **Gianluca Lazzi, Ph.D.,** University of Utah**,** lazzi@utah.edu

Title of presentation: Towards a closed-loop multi-scale simulation strategy for accurate modeling of hippocampal electrical stimulation

Bio: Gianluca Lazzi (S'94–M'95–SM'99–F'08) received the Dr.Eng. degree in electronics from the University of Rome "La Sapienza," Rome, Italy, in 1994, and the Ph.D. degree in electrical engineering from the University of Utah, Salt Lake City, UT, USA, in 1998. He is currently a USTAR Professor and Department Chair of the Department of Electrical and Computer Engineering, University of Utah.

C.   **Thomas Yankeelov,** Ph.D., University of Texas @ Austin**,** thomas.yankeelov@utexas.edu

 Title of presentation: Imaging Driven Predictive Modeling of Tumor Growth and Response to Treatment

Bio: Thomas Yankeelov, Ph.D., is the W.A. "Tex" Moncrief Professor of Computational Oncology and Professor of Biomedical Engineering and Medicine at The University of Texas at Austin. He serves as the Director of the Tumor Modeling Group in the Institute for Computational and Sciences and Director of Cancer Imaging Research for the Dell Medical School. Dr. Yankeelov develops tumor forecasting methods by employing patient-specific, quantitative imaging data to initialize and constrain predictive, multi-scale biophysical models of tumor growth with the purpose of optimizing therapies for the individual cancer patient.

D. **Adarsh Krishnamurthy,** Ph.D., Iowa State University, adarsh@iastate.edu

Title of presentation*:* Therapeutic Mechanism of Cardiac Resynchronization Therapy Explain By Patient- Specific Models of Dyssynchronous Heart Failure

Bio: Adarsh Krishnamurthy is an assistant professor in mechanical engineering at Iowa State University. He received his B.Tech. and M.Tech. (Dual Degree) in mechanical engineering with specialization in product design from Indian Institute of Technology, Madras in 2005. He received his Ph.D. in mechanical engineering from the University of California, Berkeley, in Computer-Aided Design & Manufacturing and GPU computing in 2010. Prior to his current position, he was a post-doctoral researcher in the department of bioengineering at the University of California, San Diego specializing in multi-scale patient-specific heart modeling, biomechanics, and finite-element analysis. His research interests include patient-specific modeling, biomechanics, finite element analysis, computer-aided design (CAD), real-time rendering and visualization, GPU computing, and computational geometry.

E. **Elebeoba May, Ph.D.,** University of Houston, eemay@uh.edu

Title of presentation*:* Multiscale Models of the Host-Pathogen Interface in Mtb Infection

Bio: Elebeoba E. May is an Associate Professor of Biomedical Engineering at the University of Houston's Cullen College of Engineering and an Associate Affiliate Member of the Department of Pathology and Genomic Medicine at the Houston Methodist Research Institute. Dr. May is director of the Multi-scale Immunobiology Design, Algorithms, and Simulation (MIDAS) Lab, with research focused on the design of integrated quantitative and empirical platforms for the development of multi-scale, predictive models of biological systems with an emphasis on hostpathogen interactions and microbial communities.

F. **Ravi Radhakrishnan,** Ph.D., University of Pennsylvania, rradhak@seas.upenn.edu

Title of presentation*:* Multiscale Models for the Design of Functionalized Nanocarriers: Building Next Generation Pharmacokinetic Models Customized to Disease States

Bio: Ravi Radhakrishnan is currently a Professor of Bioengineering at the University of Pennsylvania. He also holds a secondary appointment in Biochemistry and Biophysics and Chemical and Biomolecular Engineering and serves on the graduate group in Genomics and Computational Biology. Dr. Radhakrishnan is a Fellow of the American Institute of Medical and Biological Engineers (AIMBE). His research expertise is in chemical physics, statistical mechanics, and computational biology and his lab is currently funded primarily by grants from the US National Science Foundation and National Institutes of Health, as well as the European Commission. The Radhakrishnan laboratory focuses its research on biophysics of single molecules and signal transduction, with a particular focus on cancer. Dr. Radhakrishnan has authored over 105 articles in leading peer reviewed Journals and serves as a referee for over 45 leading journals, publishers, and federal funding agencies. He serves as an editorial board member of five journals, and also regularly serves as a Panelist and Study Section member for National Science Foundation and National Institutes of Health.

Title: **Multiscale Modeling & Simulation: Challenges in Model Reproducibility & Credibility**

Abstract: Speakers and the panel will focus on initiatives to promote the reproducibility and credibility of modeling & simulation applications, and technical challenges in the development of reproducible multiscale models. Examples and recent case studies in producing reproducible models will be discussed.

List of Speakers

A. **Lealem Mulugeta, In Silico Labs, LLC,** lealem.mulugeta@gmail.com

Title of presentation*:* Developing Credible Practice Guidelines for Modeling and Simulation in Healthcare: A Multifaceted Approach

Bio: Lealem Mulugeta is currently a Co-chair of the Committee on Credible Practice of Modeling and Simulation in Healthcare, as well as Chief Scientist and Executive Director of InSilico Labs LLC. He was also the Lead Scientist of NASA's Digital Astronaut Project (DAP) where he led a multidisciplinary team to implement well-validated computational models to help predict, assess and mitigate space biomedical risks. As the DAP Lead Scientist, he played a strong role in developing and implementing standardized methods for verification, validation and credibility assessment of NASA's biomedical computational models.

B. **Peter Hunter, D.Phil., Auckland Bioengineering Institute,** p.hunter@auckland.ac.nz

Title of presentation: Progress in Establishing Standards, Computational Software and Model Repositories for Reproducible Modeling of Multiscale Biological Processes

Bio: Professor Peter Hunter FRS is Director of the Auckland Bioengineering Institute (ABI) and Director of the Medical Technologies Centre of Research Excellence. His research interests are in modeling human physiology using an anatomical and biophysically-based multiscale approach that links molecular processes to tissue level phenotypes. He was awarded the Rutherford Medal and a KEA World Class NZ award in 2009 and appointed to the NZ Order of Merit in 2010. He is an elected Fellow of the Royal Society (London and NZ), Chair of the International Academy of Medical and Biological Engineering, and President-elect of the World Council of Biomechanics.

C. **Herbert Sauro, Ph.D., University of Washington,** hsauro@u.washington.edu

Title of presentation: Implementing a Reproducibility Workflow for Models Using Python and Community Standards

Bio: Herbert Sauro is a faculty member at the University of Washington in the Department of Bioengineering. He has been involved in developing modeling standards for biomedical research for almost 15 years. These standards include SBML, SED-ML, SBL, SBGN and COMBINE. His other interests include control theory applied to cellular networks, interactive simulation and high performance computing solutions for biomedical models.

D. **Elebeoba May, PhD, University of Houston, Houston, TX,** eemay@uh.edu

Title of presentation: Developing a Reproducible Model to Explore the Impact of Oxygen Dynamics on Mtb Latency

Bio: Elebeoba May is an Associate Professor of Biomedical Engineering at the University of Houston's Cullen College of Engineering and an Associate Affiliate Member of the Department of Pathology and Genomic Medicine at the Houston Methodist Research Institute. Dr. May is director of the Multi-scale Immunobiology Design, Algorithms, and Simulation (MIDAS) Lab, with research focused on the design of integrated quantitative and empirical platforms for the development of multi-scale, predictive models of biological systems with an emphasis on hostpathogen interactions and microbial communities.

E. Grace Peng, Ph.D. The National Institute of Biomedical Imaging and Bioengineering **(NIH, NIBIB)**

Title of presentation: Federal Agencies and the Development of Reproducible Multiscale Models of the Physiome

Bio: Grace Peng is Program Director for NIH/NIBIB and Chair of the Interagency Modeling and Analysis Group (IMAG). Dr. Peng's interest is in converging the interests of various agencies and scientific entities to help facilitate multiscale model development and model sharing.

Organizer I: **Ahmet Erdemi**

Organizer II: **Elebeoba May**

Organizer III: **Herbert Sauro**

Title: **Prospects of Advanced Photoacoustic and Ultrasound Imaging**

Abstract: This mini-symposium in IEEE EMBC 2016, "Prospects of Advanced Photoacoustic and Ultrasound Imaging" aims at bringing together seasoned and new researchers in the field of photoacoustic (optoacoustic) imaging, and providing a platform to foster sharing and collaboration in this vibrant research area. In particular, an in-depth panel discussion will be devoted to the potential clinical and industrial impacts of advanced photoacoustic and ultrasound.

Organizer I: **Chulhong Kim**

Title: **Cyber-Security, IoT, Wearables and the Quantified Self (QS)**

Abstract: With the advent and the gaining popularity of the Internet of Things, wearables, implantables, and the Quantified Self, many promising trends are seen, e.g., they are going to transform our lives and health - inside and outside of the doctor's office. Currently, these technologies are high on the hype cycle, but there are some difficulties. One of these difficulties is cyber security. It is not too early, however, to examine the promises of these new areas versus reality. IEEE is able to provide a wide diversity of expertise, information, and resources that are related to health, to the life sciences, and to cyber security. This expertise, however, is often distributed across many organizations and this poses challenges in integration and collaboration. One of the important functions of the Life Sciences Technical Community (LSTC) is its ability to bring together diverse pieces of expertise from the various IEEE Societies of organizations and have these parts work more as a whole. In the Mini-Symposium at EMBC 2016 on "Cyber-Security, IoT, Wearables and the Quantified Self", we will bring together, under one roof, expertise in issues related to cybersecurity in the Internet of Things, wearables and the Quantified Human. Notable experts from the various IEEE Societies and organizations and potentially from the Government and private sectors will present and discuss their related fields of expertise. The audience and the experts will then discuss how to bring it all together and propose a plan of action.

List of Speakers:

     A. **Stefano Zanero**, zanero@elet.polimi.it

     B. **Luis Kun**, HCII@aol.com

C. **Mohamad Sawan**, mohamad.sawan@polymtl.ca

D. **Donna Hudson**, dhudson@fresno.ucsf.edu

Organizer I: **Nahum Gershon**

Bio: Nahum Gershon focuses on social media, the Internet of Things and Everything(!), strategic planning, visualization, cloud computing, combining creative expressions with technology and real-time information delivery, presentation & interaction in mobile, wearable as well as traditional devices including how they could improve both organizational environments and our personal lives. Nahum Gershon has served in many capacities at the IEEE over the years and is a Senior Principal Scientist at the MITRE Corporation.

Title: **Transforming Biomedical Engineering Technologies for "a better life" Through Open Consensus Standards**

Abstract: The 21st century has brought about rapidly evolving new emerging technologies that can create great disruption in transforming our daily lives, drastically alter the structure of society, and considerably change the global economy landscape. Access to quality medical healthcare, clinical services, safe and effective medical devices as well as consumer personal electronic products are important to people in all communities around the world. The arrival of Internet of Things (IoT) era is expected to impact our daily lives in positive ways by enhancing communication through a network of new devices. Will disruptive technology --- such as, mobile computing, Internet connectivity, advanced automation, intelligent software systems, sensors, 3D printing, and next generation genomics to name a few --- bring benefit to humanity? Standards can play a critical role in technology areas that are positioned to enable disruptive technology. The IEEE/IEEE-Standards Association is an international standards development organization. In this session, our international panel across multiple disciplines will examine various technology domains, identify the challenges and discuss standards-based solutions. The objective is to bring together professionals who have key experience in innovative, emerging technologies and in the development of open consensus industry standards that enable them. A new standard development project, P2650, on mobile platforms for pre-screening audiometric systems will be introduced. It is an example of an enabling standard that can bring the power of consumer grade technologies like the mobile phones and wearable electronics to the needs of "Enabling Ability in Disability." Other topics may include the ISO/IEEE 11073 standards for Personal Health Devices (PHD); the newly formed PHD Cybersecurity tiger team; medical virtual, augmented reality for medical practice and surgical 3D printing; wearable mHealth technologies; sensor applications in smart devices.

List of Speakers:

A. **Mohan Kumar R, Chair,** IEEE EMB WG (P2650, Standard For Enabling Mobile Device Platforms To Be Used As Pre-*Screening Audiometric Systems), mohan.k.rajagopal@ieee.org*

Title of presentation: "Evolving New Standards for IoT in Communications Disability"

Bio: Mohan Kumar received his doctorate in electrical engineering from Imperial College London specializing in Ultra Low Power Wearable Diagnostic Systems. He has 22+ years of experience in the biomedical, semiconductor & healthcare industries, and is currently a Vice President at MegaChips Corporation.

B. **Malcolm Clarke,** Brunel University London, College of Engineering, Design and Physical Sciences, malcolm.clarke@brunel.ac.uk

Title of presentation: "An Introduction to the IEEE 11073 Personal Health Device Standards"

Bio: Malcolm Clarke is a Reader in Telemedicine and eHealth Systems in the Department of Information Systems and Computing, Brunel University. Dr. Clarke is former chair of the American Telemedicine Association Special Interest Group in Technology. He is active with CEN, HL7, IEEE and ISO standards committees on medical devices with 30 years experience in the medical technology field.

C. **Christoph Fischer,** Systems Engineer, Roche Diabetes Care GmbH, christoph.fischer@ieee.org

Title of presentation: "IEEE 11073 PHD Cybersecurity - Standardization of secure Plug & Play interoperability"

Bio: Christoph Fischer is co-project manager for diabetes care customer solution including insulin pumps, data management software and cloud solution. He is responsible for requirements engineering, systems engineering, System-of-systems architecture, Cybersecurity and data communication interfaces. Christoph is leading the standardization of Cybersecurity for IEEE 11073 PHD standard family.

D. **Young Lae Moon,** M.D., Professor, Orthopaedic Department Chosun University Hospital, ylm2103@gmail.com

Title of presentation: "Standard Medical AR, VR and Surgical 3D Printing"

Bio: Dr. Moon is Chair of 3D Medical Application Work Group, IEEE-SA, Member of 3D Printing Work Group, ISO-TC 261,Member of American Shoulder and Elbow Surgeon, Medical Committee of Gwangiu Universiade

E. **Yuan-Ting Zhang**, IEEE 1708 Working Group Chair, ytzhang@ee.cuhk.edu.hk

Title of presentation: "Advancing Wearable m-Health Technologies Through Standard Development: IEEE 1708 Perspectives"

Bio: Yuan-Ting Zhang is Adjunct Professor at EE Department of the Chinese University of Hong Kong. Y.T. Zhang is 2014 recipient of the IEEE-SA Emerging Technology Award for outstanding contribution and leadership as Chair of the IEEE P1708 Working Group in facilitating the creation of the first IEEE standard on wearable cuffless blood pressure measuring devices.

F. Kim Seong-Hyok, LG electronics, seonghyok.kim@gmail.com

Title of Presentation: "Healthcare Technology in Smart Mobile Devices"

Bio: Kim Seong-Hyok is Principal Research Engineer and Sensor Solution Team Leader at LG Electronics Mobile Communications Company.

Organizer I: **Carole C. Carey,** IEEE EMB Society & IEEE Life Sciences Standards Committees

Bio: Carole is a Regulatory Consultant and former US FDA. She was a Director in the Center for Devices and Radiological Health and a peer-reviewed Expert Regulatory Scientist in the Office of Device Evaluation. As a Mansfield Fellow, Carole spent a year in Japan's Ministry of Health & the Pharmaceutical and Medical Devices Agency. She earned BS/MS engineering degrees at JHU and Loyola U.

Organizer II: **Elliot B. Sloane,** IEEE EMBS 11073 MD Semantic Interoperability Standards Program Chair

Bio: Elliot is President of the Center for Healthcare Information Research and Policy. He is Co-Chair of IHE. For four decades he has worked with the research, design, forensics, academics, regulatory, and manufacturing industries to improve patient safety, clinical efficacy and efficiency, and equity of access to quality care.

Organizer II: **Jean Wheeler**

Bio: Jean Wheeler is a Regulatory Engineer and Regulatory/Quality Manager at an emerging start-up developing wireless, wearable EEG solutions for the wearable device and point of care markets. She earned her BS in Materials Science and Engineering at the University of Illinois at Urbana-Champaign.

Title: **Frontier Symposium I & II**

Organizer I: **Jose Principe,** University of Florida