Tutorials and Workshops

Full-Day
Embodied-Brain Systems Science and Neurorehabilitation
09:00 - 17:00
Location: Fantasia K
Registration Required

Organizers: **Toshiyuki Kondo, EMBS -Member**
                        Max Ortiz-Catalan, EMBS –Member
        Yukari Ohki, IEEE –Member

Speakers:

- **Prof. Jun Ota, The Tokyo University**
- **Dr. Tetsunari Inamura, National Institute of Informatics**
- **Dr. Yutaka Oouchida, Tohoku University**
- Dr. Shiro Yano, Tokyo University of Agriculture and Technology (TUAT)
- Dr. Kazumichi Matsumiya, Tohoku University
- Nicolas Schweighofer, University of Southern California Physical Therapy and Bio-kinesiology
- Prof. Hiroshi Imamizu, The University of Tokyo
- Dr. Arito Yozu, The Tokyo University
- Dr. Max Ortiz-Catalan, Chalmers University of Technology
- Dr. Marco Santello, Arizona State University of Technology
- Dr. Kazuhiko Seki, NCNP

Abstract:

There are increasing patients who are suffered by brain and peripheral nerve disorders, resulting in sensorimotor dysfunctions. However, conventional rehabilitation methods, like physical training and pain therapy, are not effective for some of the patients. We hypothesize that it is possible to establish new effective neurorehabilitation methods for those patients by combining brain science, engineering and rehabilitation medicine. For that purpose, an interdisciplinary research project has been started, which is named "Understanding brain plasticity on body representations to promote their adaptive functions (embodied-brain systems science)." The project is funded as a grant-in-aid for scientific research on innovative areas (FY2014-2018, PI: Prof. Ota) by MEXT, Japan. In the project, we aim to understand how body representations in the brain are altered in some patients, and by which methods they can be adjusted effectively to recover normal functions. We are especially focusing bodily self-consciousness (senses of body ownership and agency) and muscle synergies, which should be influenced by the body representations. The target patients could have both neurological and psychiatric disorders. Members of the program, who are professionals in different fields, are collaborating to achieve the research goals, by combining theoretical, biological and clinical studies. In the workshop, some of the members will present recent results from the collaborations, including what have been achieved and what are remained to be solved. We also invite some non-member speakers, who are approaching related problems. We will discuss what can be made by using embodied-brain systems science in the future.

Full-Day
Endoluminal Robots: Advanced Diagnosis and Targeted Therapies
09:00 - 17:00
Location: Fantasia L
Registration Required

Organizers: **Paolo Dario – IEEE and EMBS Member**
Arianna Menciassi-IEEE and EMBS Member
Gastone Ciuti - IEEE Member
Leonardo Ricotti -IEEE Member

Speakers:

- Paolo Dario, The BioRobotics Institute of Scuola Superiore Sant'Anna
- Arianna Menciassi, The BioRobotics Institute of Scuola Superiore Sant'Anna
- Robert J. Webster III, Vanderbilt University
- Gastone Ciuti, The BioRobotics Institute of Scuola Superiore Sant'Anna
- Leonardo Ricotti, The BioRobotics Institute of Scuola Superiore Sant'Anna
- Alberto Arezzo, University of Turin
- Misra Sarthak, University of Twente
- Jake Abbott, University of Utah
- Ferdinando Rodriguez y Baena, Imperial College
- Mamoru Mitsuishi, University of Tokyo

Abstract:

The scope of this workshop is to advance knowledge in the field of endoluminal robotics, by describing smart tethered and untethered instruments, capsule-based robots and other diagnostic and therapeutic platforms, ranging from the meso- to nano-scale. A wide range of open challenges about endoluminal robots will be addressed in the proposed workshop, entitled "Endoluminal Robots: Advanced Diagnosis and Targeted Therapies". Ranging from active navigation mechanisms to sensing and therapeutic modules, the presentations will cover key aspects of smart robotic devices for endoluminal procedures approaching issues, such as: i) capsules and novel flexible endoscopic devices, ii) robotic navigation for active endoscopic capsules and smart probes, iii) sensing and therapeutic modules and iv) micro- and nano-scale devices.

Full-Day
A Hands-on Approach to Neural Connectivity Inference Methods
09:00 - 17:00
Location: Fantasia M
Registration Required

Organizers: **Luiz A. Baccalá-IEEE Member - EMBS TC BSP Member**
            Koichi Sameshima-IEEE Member - EMBS TC BSP Member
            Laura Astolfi - IEEE EMBS Member- EMBS TC BSP Chair

Speakers:

- **Mingzhou Ding, University of Florida**
- **Koichi Sameshima, University of Sao Paulo**
- **Luiz A. Baccalá, University of São Paulo**
- **Laura Astolfi, University of Rome Sapienza**

Abstract:

The workshop aims to provide a hands-on learning opportunity through the use of parts of the software distributed via the ''Methods in Brain Connectivity Inference through Multivariate Time Series Analysis' book (2014) from CRC which we co-edited. In addition to examining in detail conceptual aspects associated to connectivity estimation from neuro-electrical and hemodynamic data we intend to shorten the learning curve of potential users of connectivity analysis software in regard to inferential aspects and the possible caveats and pitfalls the user may encounter. The full day of activity will consist of short morning overview talks, addressing the basic principles, methodological issues, caveat and pitfalls, and examples of application of the software to real data followed by an afternoon devoted to software use and one-to-one discussion with attendees who will have the opportunity to process workshop examples and their own data by bringing their own laptops. This will enable them to benefit from discussing their results and modelling diagnostics with the workshop experts. Attendee provided Matlab/Octave licenses are required for those wishing to take part in the practical activities.

Half-Day Workshop
From Laboratory Test Rigs to Clinical Applications in Peripheral Neuropathies Diagnosis
09:00 - 12:30
Location: Fantasia A
Registration Required

Organizers: Ferdinando Cannella, PhD

```
            Prof. Paolo Liberini, PhD
            Maria Laura D'Angelo, PhD Candidate
```

Speakers:

- Ferdinando Cannella, Istituto Italiano di Tecnologia, Genoa, Italy
- Maria Laura D'Angelo, Istituto Italiano di Tecnologia, Genoa, Italy

Abstract:

It is useless to highlight the importance of the sense of the touch, because everybody knows that all the physical interactions with the environment generate touch sensations. In fact the first scientific study about it began in the middle of 19th century thanks to Weber who defined the JND (Just Noticeable Displacement). Later Blix, Donaldson and Goldschneider, and after them von Frey all conjectured a straightforward relationship between stimulus, receptor, afferent nerve fiber and subjective sensation, with regard to specificity. Thanks to these researcher pioneers several devices were designed and built for investigate the human report to the tactile stimulus.

Half-Day Workshop
Research on Children Development: New Perspectives and Tools
09:00 - 12:30
Location: Fantasia B
Registration Required

Organizers: Francesca Cecchi –IEEE, RAS, EMBS Member
Fabrizio Taffoni-IEEE Member

Speakers:

- Paolo Dario, the BioRobotics Institute, Scuola Superiore Sant'Anna, Italy
- Fabrizio Taffoni, Università Campus Bio-Medico, Rome, Italy
- John-John Cabibihan, Qatar University, Doha, Qatar
- Chung Hyuk Park, George Washington University

Abstract:

Research in the field of Mechatronics and Robotics has opened a new interesting perspective in neuroscientific and psychological studies providing new tools to investigate more in details, motor control in childhood. This has fostered the acquisition of new insights about this topic and it has enabled the possibility to develop new computational models strongly related to behavioral neuroscience. On the other hand, the new theoretical insights about motor development has allowed to further refine technology so establishing a de-facto cross-fertilization between the two levels of research. The goal of this workshop is to present current and future trends in this field involving researchers in the area of biomedical engineering, robotics, life sciences, and neuroscience. The objective is to bring together researches on motor development in childhood (focused on different diseases such as cerebral palsy and autism), from a technological and a theoretical point of view in order to create a network of contacts focalized on these specific aspects of research.

Half-Day Workshop
The Fast-Changing Landscape of Electroencephalography

09:00 - 12:30
Location: Fantasia C
 Registration Required

Organizer: Walter G. Besio-IEEE Member

Speakers:

- Nicola Soldati Ph.D., Brain Products GmbH
- Willian G. Coon, Ph.D. g.tec neurotechnology
- Ken Graap, Ph.D, BioPac Systems
- Walter Besio, Ph.D., CREmedical Corp. and University of Rhode Island

Abstract:

This workshop is designed to give both novice and experienced electroencephalography (EEG) users a synopsis of the latest innovations in EEG and related areas. EEG is the recording of brain electrical activity from the scalp. The EEG measures the difference in potentials between electrodes generated by ionic currents flowing within neurons of the brain. For many years EEG has had limited use due to poor signal quality, low spatial resolution, and non-portability. Even with these limitations EEG is still a standard practice in clinical settings such as diagnosis of epilepsy and for research such as brain computer interfacing. In recent years electrodes, signal acquisition hardware, and signal processing software have undergone major improvements allowing new and improved applications of EEG. We will have talks and demos from four groups on their latest technologies for acquiring and processing the EEG which are making the use of EEG more practical. The target audience of the workshop is the whole community of the IEEE EMBS Society interested in brain research.

Half-Day Workshop
Start-Up IP roadmap: The dos and don'ts of protecting your medical device ideas
09:00 - 12:30
Location: Fantasia D
Registration Required

Organizers: Dorin Panescu, Ph.D., FIEEE
         Dieter Haemmerich, Ph.D.
Speakers:

- **Howard Levin, M.D.**
- **Theodore Papagiannis, J.D.**
- **Mark Gelfand, M.D.**
- **Michael R. Christensen, J.D.**
- **Nitish Thakor, Ph.D.**

Abstract:

Recently, the USPTO changed its rules from "First to invent" to "First to file." This change
implies that a patent may be issued to whoever filed first, even if someone else invented first. Given that many medical-device start-ups first launch or use their products outside the US, it is imperative to understand how international patent filings work (e.g. Patent Cooperation Treaty (PCT). These intellectual property (IP) activities tend to consume significant resources and funds. Therefore, it is important, particularly for start-ups, to know how to assess which ideas are worth patenting, when it is more effective to license, or when to keep things under the wraps (e.g. not divulge the 'secret sauce'). Our workshop gathers patent-law and tech transfer experts and founders of successful start-ups and will

provide hands-on experience on how to do deal with such matters yourself. There will be ample time for questions and answers to discuss each topic in depth.

Half-Day Workshop
Communication, Restoration of Function, and Consciousness Assessment with BCI
09:00 - 12:30
Location: Fantasia E
Registration Required

Organizers: **Dr. Christoph Guger, PhD**
               Dr. William Coon, PhD

Speakers:

- **Dr. Nuri Firat Ince, PhD, Dept. of Biomedical Engineering, University of Houston, Texas**
- Dr. Tomasz Rutkowski, PhD, Dept. of Computer Science, University of Tsukuba, Japan
- Dr. Jonathan Brumberg, PhD, Dept. of Speech-Language-Hearing, Univ. of Kansas, Kansas
- Dr. William Coon, PhD, g.tec neurotechnology USA

Abstract:

Brain-Computer Interface (BCI) research has been a hot topic in the past decades. BCIs, which provide a direct connection from the human brain to a computer, translate brain activity into control signals for numerous applications, including tools to provide means to communicate, restore lost function, and help patients with disorders of consciousness (DOC). Imagine being able to think, hear, and feel - but not to move or communicate. Many potentially communicative non-responsive patients might be undetectable through standard clinical testing This part of the workshop will give an overview of groups that aim to use BCI technology to identify non-responsive patients that might be able to communicate, and will introduce state-of-the-art technology for advanced consciousness assessment. It will go on to introduce further populations that could benefit from BCIs for communication and control, and describe the latest state-of-the-art systems that aim to achieve this functionality by using motor-imagery (MI) and/or evoked potential BCIs.
Furthermore, in the last few years a totally novel and promising application for motor-imagery (MI) based BCIs has gained great attention. Several recent articles have shown that MI-based BCIs can induce neural plasticity and thus serve as an important tool to enhance motor rehabilitation for stroke patients. The overall goal of this BCI system is not communication, but improved stroke recovery by activating sensorimotor cortex. This activation is translated into control signals for rehabilitation devices like Virtual Reality environments showing moving limbs of avatars, robotic devices attached to the patient's paralyzed limbs such as exoskeletons, or
functional electrical stimulation. The audience will get familiar with all the required hardware and software, procedures for cap mounting, training and classifier setup, and BCI operation for both approaches. We will invite audience members to participate in live demonstrations, providing real-world examples of modern BCI performance in field settings. Workshop supported by g.tec medical engineering, GmbH.

Half-Day Workshop
Robust and Reliable Timestamps for Remote Patient Monitoring

09:00 - 12:30
Location: Fantasia F
Registration Required

Organizers: Malcolm Clarke, IEEE Senior Member
Michael Kirwan

Speakers: TBD

Abstract:

Having robust timestamps for remote patient monitoring is essential to ensure correct context and correlation with other data. However typical devices have no clock or a simple clock that is not synchronized. The gateway that forwards data from the local devices to the enterprise will be responsible for translating timestamps to local time and also to an underlying continuous time reference, ideally UTC. However gateways operate in harsh conditions and may not be able to synchronize their time to an accurate reference or local time. It is necessary to be able to denote the operating conditions of the gateway and the translation applied to any timestamp to ensure the integrity of data. This interactive workshop will review the problem, identify the issues, examine current approaches, and explore solutions and mitigation [2]. It will consider the guidelines published by Continua Alliance [1] that have been designed to address the issues in order to determine limitations and identify gaps.

Half-Day Tutorial
Structural and Functional Imaging with Optical Coherence Tomography and Optical Coherence Elastography
09:00 - 12:30
Location: Fantasia N
Registration Required

Organizers: Kirill V. Larin-IEEE Member

Abstract:

This tutorial will overview recent advances in development and application of optical imaging techniques for structural and functional imaging and sensing of various transport, developmental, and disease progression in tissues and cells. Special emphasis will be devoted to theory and applications of novel imaging/sensing modality – Optical coherence Tomography (OCT) and Optical Coherence Elastography (OCE). This tutorial will start with basic description of light-tissue interaction including structural and optical models of tissues with single and multiple scattering. It will be shown that light reflection, transmission, scattering, and state of polarization can be effectively controlled by changes of tissue structure and the refractive index of tissue components. Many examples of OCT noninvasive sensing will be provided such as cardiovascular imaging, ophthalmic applications, monitoring of drug diffusion and optical clearing, sensing and quantifying of microbubbles and nanoparticles in tissues and blood, imaging of early embryonic cardiovascular system development, and, the newest hot topic, assessing biomechanical properties of tissues.

Intended Audience: Engineers, scientists and physicians who are interested in learning optical imaging and spectroscopy, laser methods, instruments design, and application for medical science and clinics will find this course useful.

Half-Day Tutorial
Biomedical Signal Analysis in the era of Internet of Things and Data Analytics
09:00 - 12:30
Location: Sorcerer's Apprentice 1
Registration Required

Organizer: **Sri Krishnan, IEEE Senior Member and EMBS TC Member for Biomedical Signal Processing**

Abstract:

The talk will cover physiological signal sensing, computational sensing (compressive sensing and sparsity), signal decomposition approaches for pre-processing (denoising, detrending and artifact removals), time-frequency and tensor signal processing for extraction of non-stationary and non-linear features, clustering approaches for pattern classification. Experimental results and suggestions on how these signal processing methods could be applied in the context of Internet of Things for "quantified" self and daily/frequency monitoring of activities such as cardiac, gait, sleep and other human motions.

Half-Day Tutorial
Point of Care Medical Device Communication: IEEE P11073-20701 Hands-On Implementation
09:00 - 12:30
Location: Fantasia P
Registration Required

Organizers: **Björn Andersen -EMBS Member**
                          Martin Kasparick -EMBS Member

Speakers:
- Martin Kasparick, University of Rostock
- Björn Andersen, University of Lübeck

Abstract:

At the EMBC 2015 in Milan, the invited session on Standardisation, Opportunities and Challenges of Point of Care Medical Devices received the attention of scientists and implementers alike. Researchers from three continents presented their work on communication patterns, medical device interoperability leveraging the IEEE 11073 standard, integrating DICOM devices, supporting the surgical workflow, connecting clinical information systems, and regulatory science.
As the definition of a communication architecture and protocol for point of care medical devices has reached a stable state, it is now being standardised as part of the IEEE 11073 family, specifically part P11073-20701.
This hands-on tutorial offers the opportunity for researchers and implementers to learn how to represent a medical device's capabilities on the network using the P11073-10207 Domain Information and Service Model through a set of easy-to understand example devices. Publishing these descriptions via web services as specified in P11073-20702 Medical Devices Profile for Web Services, they can be remotely accessed by clients on the network. This tutorial will also feature the implementation of a simple client application to read out and modify some of the device's data fields and subscribe to notifications.

Attendees are required to bring a portable or tablet PC (with a keyboard) and basic pro-gramming skills. Using one of three reference implementation libraries of the standardised data exchange protocol, they will implement device representations and client applications in a browser-based development environment and test these with each other as well as with other provided components.

The interoperability achieved through compliance to this communication architecture and protocol enables the development of innovative system and device functionality that builds on data integration, e. g. clinical decision support or computerassisted surgery.

Half-Day Workshop
Current and future directions of ECoG based mapping and BCI research
13:30 - 17:00
Location: Fantasia B
Registration Required

Organizers: **Dr. Christoph Guger**
              Dr. William Coon, PhD

Speakers:

- **Dr. Kyousuke Kamada, MD, PhD, Dept. of Neurosurgery, Asahikawa University, Japan**
- Dr. Milena Korostenskaja, PhD, Florida Hospital for Children, Orlando, FL
- Dr. Aysegul Gunduz, PhD, Dept. of Biomedical Engineering, Univ. Florida, Gaines-ville, FL
- Dr. William Coon, PhD, g.tec neurotechnology USA, Inc., Albany, NY

Abstract:

Research groups all over the world are working intensively on the task of generating individual maps of a human's brain in order to exactly locate functional regions. Those regions, once identified, open huge potential, on the one hand for the treatment of neurological disorders like epilepsy, prior to invasive brain surgeries, and on the other hand also for future applications like direct brain-machine interfaces. This workshop highlights practical aspects of diverse methods of functional mapping – starting from classical electrical stimulation mapping to passive functional mapping using electrocorticographic (ECoG) signals.
Many studies over the past decade have shown that ECoG activity in the high gamma band is a reliable indicator of local task-related cortical activity, and could thus com-plement existing methods for functional mapping.
Further highlights of the workshop are new approaches of semiautomatic mapping of the sensorimotor cortex using somatosensory evoked potentials and cortico-cortical evoked potentials for brain mapping in intraoperative scenarios; as well as semiautomatic evaluation of electrical cortical stimulation results and passive functional mapping results, decoding of limb movement, new approaches in the treatment of movement disor-ders, invasive BCI applications; and much more.
The speakers of this workshop provide a competent mix between neurosurgery, neurology, scientific and technical expertise. They will highlight state-of-the-art research as well as practical clinical aspects related to brain mapping. The audience will see all the required hardware and software, passive functional mapping, procedures for semiau-tomatic electrical cortical stimulation, training and montage setup, and mapping oper-ation.

Half-Day Workshop
NSF SCH Aspiring PI Workshop
13:30 - 17:00
Location: Fantasia C
Registration Required

Organizers: Wendy Nilsen
           Meghan Murphy

Speakers:
- **Misha Pavel, Northeastern University**
- **Paolo Bonato, Harvard University**
- **Donna Spruijt-Metz, University of Southern California**
- **Richard Conroy, NIH**

Abstract:

This workshop will be an informational and interactive opportunity for Smart and Connected Health (SCH) Aspiring Investigators to develop skills and address the knowledge gaps necessary to submit a successful SCH proposal. The goal of the SCH program is to accelerate the development and use of innovative approaches that would support the much needed transformation of health and healthcare. The mission of the Smart and Connected Health program is the development of next generation health and healthcare research through high-risk, high-reward advances in the understanding of applications in information science, computer science, behavior, cognition, sensors, robotics, bioimaging, and engineering. Realizing the promise of disruptive transformation in health and healthcare will require well-coordinated, multi-disciplinary approaches that draw from the computer and information sciences, engineering, medical, health and social behavioral sciences. The Aspiring Investigator workshop will support the development of researches interested in submitting research to the SCH program. The workshop will accomplish this through mentorship and didactic sessions to acquaint Aspiring investigators with the key issues associated with SCH, the joint NSF-NIH review process, and the breadth of existing projects funded by the SCH program.

Seminar Outline
I. Introduction and Welcome -- 15 min -- Wendy Nilsen
II. What is Smart and Connected Health -- 30 min -- NIH and NSF Program Staff
Discussion of the types of research supported through Smart and Connected Health, common challenges that PIs encounter with proposals to SCH, and tips for improving SCH proposals.
III. Mock review -- 45 min -- Program Staff and Current SCH PIs
Participants will observe a mock review of an SCH proposal. Current SCH grantees and experienced reviewers will serve as the mock panel. Aspiring PIs will gain valuable insight into what reviewers consider when making recommendations for the SCH program.
IV. Small group mentoring -- 75 min -- Program Staff and Current SCH PIs
SCH grantees and program staff will mentor Aspiring PIs on developing research proposals appropriate for the SCH program.

Half-Day Tutorial
Computational Learning Approaches to Data Analytics in Biomedical Applications
13:30 - 17:00
Location: Sorcerer's Apprentice 1
Registration Required

Organizers: Dr. Donald Wunsch II

Dr. Tayo Obafemi-Ajayi

Speakers:
- Dr. Donald Wunsch II, Missouri University of Science and Technology (Missouri S&T)
- Dr. Tayo Obafemi-Ajayi, Missouri University of Science and Technology (Missouri S&T)
- Bryce Schumacher, Missouri University of Science and Technology (Missouri S&T)

Abstract:

The advancement of translational medical research to achieve personalized medicine has increased demand for computational intelligence tools that can perform robust analysis, rapid interpretation and learn solutions from the increasing amount of data generated by biomedical applications. Machine learning involves both supervised learning (classification) and unsupervised learning or exploratory data analysis (clustering). There are many rich theories and applications of computational learning approaches to data analytics arising from a wide variety of communities, ranging from engineering and computer sciences (computational intelligence, data mining, information retrieval, machine learning, pattern recognition), life and medical sciences (biology, clinic, genetics, microbiology, paleontology, pathology, psychiatry, phylogeny), and earth sciences to social sciences (anthropology, psychology, sociology) and economics (business, marketing). Such diversity causes confusion because of differing terminologies, goals and lack of good communication between communities. This tutorial will help the audience understand this field as it relates to biomedical applications and translational medicine.
We will begin with an introduction and discussion of the major problems relating to data analytics in biomedical applications. We will provide a review of important, influential, and state-of-the-art learning algorithms in literature for biomedical applications with special emphasis on clustering algorithms. We will review cluster validity indices and discuss how to select the appropriate one for one's data. The tutorial will include hands-on training on use of intuitive software tools. We encourage participants to come prepared with a brief synopsis of what type of biomedical data they are interested in. They can bring their own data or we will have sample datasets that relate specifically to phenotype medical datasets and genomic data.

Outline:
- Overview of data analytics in biomedical applications and current challenges
- Supervised learning algorithms and applications
- Clustering algorithms
- Cluster validation indices
- Computational tools for biomedical data analysis
- Hands-on training on use of Python libraries, WEKA, SAP-HANA and R-server

Half-Day Tutorial
Magnetic Resonance Imaging for Evaluating the Heart Function: State-of-the-Art Techniques

13:30 - 17:00
Location: Fantasia N
Registration Required

Organizer: El-Sayed H. Ibrahim - IEEE Member

Speakers:
- Prof. El-Sayed Ibrahim, University of Michigan
- Prof. Choukri Mekkaoui, Harvard University
- Prof. Andreas Schuster, Universitätsmedizin Göttingen
- Prof. Dimitri Metaxas, Rutgers University
- Prof. Ahmed Fahmy, Nile University
- Prof. El-Sayed Ibrahim, University of Michigan
- Prof. Ralph Sinkus, King's College London
- Prof. Frederick Epstein, University of Virginia

Abstract:

The cardiovascular disease (CVD) is the leading cause of death worldwide with huge associated cost for prevention and treatment. Magnetic resonance imaging (MRI), with its unprecedented capabilities, provides valuable measures about the heart function. These measures, especially those of regional cardiac function, allow for early intervention and efficient treatment planning in CVD patients. Different MRI techniques have been developed over the past 25 years to measure the heart function, including myocardial tagging, harmonic-phase (HARP) analysis, displacementencoding with stimulated echoes (DENSE), strain-encoding (SENC), tissue phase mapping (TPM), feature tracking cine imaging, and magnetic resonance elastography (MRE). These advanced techniques resulted in different types of MRI images that need special postprocessing to efficiently extract accurate and meaningful information about the heart function, especially that each technique has its own advantages and limitations. The tutorial summarizes the efforts I spent in the past 5 years, writing a book about this topic (https://www.crcpress.com/Heart-Mechanics-Magnetic- Resonance-Imaging--The-Complete-Guide/Ibrahim/9781466512221), with contributions from world experts who will be presenting in this tutorial. The tutorial is divided into eight 25-mintes presentations (20 minutes for the presentation and 5 minutes for panel discussion), each focusing on one category of the aforementioned imaging techniques. The first presentation provides an overview of the whole tutorial, including historical background and introduction to the techniques covered in the tutorial. Each of the following six presentations covers the basic principles of the imaging techniques, techniques' implementation, techniques' advantages and limitations, and technical challenges. The last presentation focuses on clinical applications, current technical challenges, and future development trends. By the end of every 4 sessions, there will be a 10-minute break to meet with the speakers for one-on-one friendly discussions. By the end of this tutorial, the audience will obtain comprehensive and up-to-date knowledge about state-of-the-art MRI techniques for evaluating the heart function and mechanical properties.

Half-Day Tutorial
Signal processing methods in Sleep Research
13:30 - 17:00
Location: Fantasia P
Registration Required

Organizer: Gary Garcia-Molina-IEEE Member

Speakers:
- **Gary Garcia-Molina, Philips Research North America and University of Wisconsin-Madison**

Abstract:

By occupying nearly a third of human lifespan, sleep constitutes the main activity of the human brain. Numerous recent theories on the function of sleep confirm its beneficial role at multiple physiological levels. Together with physical activity and nutrition, sleep is a corner stone of healthy living. However, latest trends show that our society has been progressively curtailing sleep in benefit of other activities. Numerous portable (consumer or medical type) devices have recently emerged that monitor signals that can provide information about sleep that is relevant for patients, physicians, or consumers. The types of signals acquired with portable devices and can provide sleep relevant information are of a large variety including: movement (actigraphy), muscle activity (electromyography), ocular activity (electrooculography), cardio-respiratory activity (electrocardiogram, breathing effort), electroencephalography, and photopletismography. Signal processing plays an important role in the analysis and interpretation of these signals in the context of sleep. Sleep research poses interesting signal processing challenges. In offline processing, the challenge is the inherent long duration of recordings and the relatively high sampling frequency necessary to capture important microevents to understand the restorative function of sleep. In online processing, the challenge is to locally identify sleep states (REM or NREM stages) in real-time and with short latency.

In this tutorial lecture, the main theories on the function of sleep are presented first followed by a general introduction on sleep science, the types of sleep, sleep architecture, and polysomnography. In the second part of the tutorial, the focus is on signal processing methods. The analysis of the sleep macro-structure in terms of sleep stages is first presented followed by the analysis of sleep microstructure in terms of events such as spindles and slow-waves. Sleep models (sleep dissipation, circadian model, and sleep inertia) are also presented. Finally current trends in sleep research and the relevance of signal processing are presented.

Half-Day Tutorial
IEEE11073 Personal Health Devices Educational Session
13:30 - 17:00
Location: Fantasia D
Registration Required

Organizers: Malcolm Clarke, Brunel University,Senior Member, IEEE
William Ash, IEEE Standards Association

Speakers:
- Malcolm Clarke, Brunel University,Senior Member, IEEE

Abstract:

The session will present a tutorial on the IEEE 11073 Personal Health Device (PHD) standards. The session will cover the theory of the IEEE 11073-20601 base standard, the -104xx

specializations and the current transport technologies (BT, BT LE, USB and ZigBee). The session will explain the domain information model, service model, and nomenclature and how these are used to model real devices. The session will cover practical examples of devices from the separate domains of telehealth, independent living, and health and fitness. The session will describe the advantages to research and industry applications.

Wednesday, 17 August 2016

General Program

Oral Sessions
08:00 -09:30
Location: Main & Second Levels
Open to all registered conference attendees

Student Paper Competition Session I
08:00 – 09:30
Location: Atlantic B
Open to all registered conference attendees

> Finalists of the Student Paper Competition present their papers in three special sessions. First, second and third place winners will be selected and receive monetary awards. The award ceremony will take place on Thursday's 09:35 Keynote session in the Ballroom of Americas.

Plenary Lecture
Human Genomics, Precision Medicine, and Advancing Human Health
09:45 – 10:45
Location: Ballroom of Americas
Open to all registered conference attendees

Speaker: **Eric D. Green,** M.D., Ph.D. Director of the National Human Genome Research Institute (NHGRI) at the National Institutes of Health (NIH)

Exhibits
10:00 - 17:00
Visit the exhibits located in the Fantasia F, G & J
Open to all registered conference attendees

Poster Session and Coffee Break
10:45 – 11:00
Location: Fantasia F, G & J
Open to all registered conference attendees

Oral Sessions
11:00 – 12:30
Location: Main & Second Levels
Open to all registered conference attendees

Student Paper Competition Session II
11:00 – 12:30
Location: Atlantic B
Open to all registered conference attendees

Finalists of the Student Paper Competition present their papers in three special sessions. First, second and third place winners will be selected and receive monetary awards. The award ceremony will take place on Thursday's 09:35 Keynote session in the Ballroom of Americas.

Lunch with Leaders
12:30 - 14:00
Location: West Rotunda
Registration required

Organizer: **Nessa Johnson-EMBS Student Representative**

Hungry for a chat? All EMBS students are invited to register to one (of three) free lunches at the EMBC'16. Approximately ten students are seated per table where leaders of the biomedical engineering community are waiting to engage in informal conversation over a delicious and complimentary lunch. This is a rare and invaluable opportunity for you, as a student, to talk to a world leader, get some advice and network in your field. Registration in advance is required, as spaces are limited. Students may only attend one out of the three Lunch with Leaders. The list of Leaders in attendance is subject to change due to scheduling conflicts with the Conference.

BRAIN Plenary Symposium
13:30 – 15:00
Location: Ballroom of Americas
Open to all registered conference attendees

Chairs:	**Bin He,** University of Minnesota
	Walter Korshetz, National Institute of Neurological Disorders and Stroke
	Karl Deisseroth, Stanford University

Speakers:

Walter Korshetz, M.D. Director National Institute of Neurological Disorders and Stroke
Presentation Title: BRAIN Initiative Overview and Challenges

Karl Deisseroth, M.D., Ph.D. DH Chen Professor of Bioengineering and Psychiatry and Behavioral Sciences and Howard Hughes Investigator, Stanford University
Presentation Title: Optogenetics and CLARITY

Bin He, Ph.D. Distinguished McKnight University Professor of Biomedical Engineering, Medtronic-Bakken Chair, Director of the Institute for Engineering in Medicine and of the Center for Neuroengineering, University of Minnesota
Presentation Title: Mapping and Controlling Human Brain Dynamics

Poster Session and Coffee Break
15:00 – 15:30
Location: Fantasia F, G & J
Open to all registered conference attendees

Ignite & Oral Sessions
15:30 – 17:00
Location: Main & Second Levels
Open to all registered conference attendees

Student Paper Competition Session III
17:00 – 19:00
Location: Atlantic B
Open to all registered conference attendees

Finalists of the Student Paper Competition present their papers in three special sessions. First, second and third place winners will be selected and receive monetary awards. The award ceremony will take place on Thursday's 09:35 Keynote session in the Ballroom of Americas.

Networking I: Navigating Your Academic Career
17:00 – 19:00
Location: Pastoral 2
Open to all registered conference attendees

Poster Session
17:00 – 19:00
Location: Fantasia F, G & J
Open to all registered conference attendees

Attendee & Student Welcome Reception
19:00 – 21:00
Porte Cochere
Open to all registered conference attendees - Guests may purchase tickets.

This year's EMBS conference will hold one reception where students and attendees come together for this great networking opportunity. The reception will include open bar and heavy Hors' D Oeuvres.

General Program

Oral Sessions
08:00 -09:30
Location: Main & Second Levels
Open to all registered conference attendees

Theme Keynote Lecture
Building a Triborough Bridge for Critical Care Medicine: Connecting Patients, Data and Real-Time Analytics
09:45-10:45
Location: Grand Republic Ballroom
Open to all registered conference attendees

Speaker: **Timothy Buchman,** M.D., Ph.D. Emory University School of Medicine

Theme Keynote Lecture
Precision Surgery – from Imaging, Molecular Oncology to Robotics
09:45-10:45
Location: Ballroom of Americas
Open to all registered conference attendees

Speaker: **Guang-Zhong Yang,** PhD, FREng Director and co-founder of the Hamlyn Centre for Robotic Surgery, Imperial College London, UK

Exhibits
10:00 - 17:00
Visit the exhibits located in the Fantasia F, G & J
Open to all registered conference attendees

Poster Session and Coffee Break
Location: Fantasia F, G & J
10:45 – 11:00
Open to all registered conference attendees

Oral Sessions
11:00 – 12:30
Location: Main & Second Levels
Open to all registered conference attendees

Lunch with Leaders
12:30 - 14:00
Location: West Rotunda
Registration required

Organizer: **Nessa Johnson-EMBS Student Representative**

Hungry for a chat? All EMBS students are invited to register to one (of three) free lunches at the EMBC'16. Approximately ten students are seated per table where leaders of the biomedical engineering community are waiting to engage in informal conversation over a delicious and complimentary lunch. This is a rare and invaluable opportunity for you, as a student, to talk to a world leader, get some advice and network in your field.

Registration in advance is required, as spaces are limited. Students may only attend one out of the three Lunch with Leaders. The list of Leaders in attendance is subject to change due to scheduling conflicts with the Conference.

Theme Keynote Lecture
Building a Triborough Bridge for Critical Care Medicine: Connecting Patients, Data and Real-Time Analytics
14:00-15:00
Location: Sorcerer's Apprentice Ballroom
Open to all registered conference attendees

Speaker:　　　　**Merryn Tawhai,** Ph.D. Professor of Bioengineering, University of Auckland, NZ

Symposium
The Quantified Self: Visions for the Next Decade of Persistent Physiological Monitoring
13:30-15:00
Location: Grand Republic Ballroom
Open to all registered conference attendees

Chairs:　　　　**Nahum Gershon,** MITRE
　　　　　　　　　Justin Sanchez, DARPA

Speaker:　　　　**Dave deBronkart,** e-Patient Dave, International keynote speaker, author and health policy adviser
　　　　　　　　　Presentation Title: I Barely Survived Cancer and Nobody Knows Why

　　　　　　　　　Wendy Nilsen, Program Director for the Smart and Connected Health program at NSF and Health Scientist Administrator at the NIH Office of Behavioral and Social Sciences Research (OBSSR)
　　　　　　　　　Presentation Title: Turning the Quantified Self Into a Healthier Population

　　　　　　　　　Larry Smarr, Founding Director of the California Institute for Telecommunications and Information Technology (Calit2), a UC San Diego/UC Irvine partnership
　　　　　　　　　Presentation Title: Linking Phenotype Changes to Internal/External Longitudinal Time Series in a Single Human

Symposium
Advanced Biomedical and Health Informatics for Personalized, Predictive, and Precision Health
13:30-15:00
Location: Ballroom of Americas
Open to all registered conference attendees

Chairs:　　　　**Shankar Subramaniam,** UCSD
　　　　　　　　　May D. Wang, Georgia Tech and Emory Univ.

Speaker:　　　　**Raimond L. Winslow,** Ph.D., The Institute for Computational Medicine and Department of Biomedical Engineering, The Johns Hopkins University School of Medicine and Whiting School of Engineering
　　　　　　　　　Presentation Title: WaveformECG: A Web-Based Platform for Managing, Visualizing, Annotating, and Analyzing ECG Data

　　　　　　　　　Edward Harry Livingston M.D.
　　　　　　　　　Presentation Title: The EMR: What Went Wrong and How Can We Fix It?

　　　　　　　　　Avi Ma'ayan, Ph.D.
　　　　　　　　　Presentation Title: Collecting and Exploring Gene Signatures

Poster Session and Coffee Break
15:00 – 15:30
Location: Fantasia F, G & J
Open to all registered conference attendees

Ignite & Oral Sessions
15:30 – 17:00
Location: Main & Second Levels
Open to all registered conference attendees

Meet the Editors of EMBS Publications
15:30 – 17:00
Location: Pacific
Open to all registered conference attendees

> The "Meet the Editors" session will follow the "Technical Writing and Manuscript Preparation session" where each EiC will shortly present their journal and what they are looking for an a manuscript submission. This will be followed by interactive Q&A where participants have an opportunity to learn about the IEEE EMBS Journal and Magazine publications.

Poster Sessions
17:00 – 19:00
Location: Fantasia F, G & J
Open to all registered conference attendees

Technical Writing Workshop: Getting Published in Biomedical Engineering Journals
17:00 – 19:00
Location: Grand Republic C
Open to all registered conference attendees

> From start to finish, the entire writing process of an academic publication will be covered in this session. The talks will first provide an overview of the structure of a scientific article, and will outline methods for improving your writing skills. A review of the editorial process will follow, whereby the salient "do's" and "don'ts" will be discussed. The overall aim of this session is to help you improve your technical writing, explain the science/engineering you are working on, and inevitably, get your work published in an academic journal.

Volunteer Activities: Summer Schools/Chapters/International Student Conferences
17:00 – 19:00
Location: Grand Republic D
Open to all registered conference attendees

General Program

Oral Sessions
08:00 -09:30
Location: Main & Second Levels
Open to all registered conference attendees

Theme Keynote Lecture
Creating a Smart and Connected Health System
09:45 -10:45
Location: Ballroom of Americas
Open to all registered conference attendees

Speaker: **Wendy Nilsen,** Ph.D. Health Scientist Administrator at the NIH Office of Behavioral and Social Sciences Re-
                  search (OBSSR)

Theme Keynote Lecture
Redefining the Spatiotemporal Limits of Optical Imaging: Photoacoustic Tomography, Wavefront Engineering, and Compressed Ultrafast Photography
09:45 -10:45
Location: Grand Republic
Open to all registered conference attendees

Speaker: **Lihong Wang,** Ph.D. Gene K. Beare Distinguished Professorship of Biomedical Engineering, Washington Uni-
                  versity

Exhibits
10:00 - 17:00
Visit the exhibits located in the Fantasia F, G & J
Open to all registered conference attendees

Poster Session and Coffee Break
10:35 – 11:00
Location: Fantasia F, G & J
Open to all registered conference attendees

Oral Sessions
11:00 -12:30
Location: Main & Second Levels
Open to all registered conference attendees

National Science Foundation Graduate Research Fellowship Program Information Session
11:00 -12:30
Location: Grand Republic D
Open to all registered conference attendees

Lunch with Leaders
Location: West Rotunda
12:30 - 14:00
Registration required

Organizer: **Nessa Johnson-EMBS Student Representative**

Hungry for a chat? All EMBS students are invited to register to one (of three) free lunches at the EMBC'16. Approximately ten students are seated per table where leaders of the biomedical engineering community are waiting to engage in informal conversation over a delicious and complimentary lunch. This is a rare and invaluable opportunity for you, as a student, to talk to a world leader, get some advice and network in your field. Registration in advance is required, as spaces are limited. Students may only attend one out of the three Lunch with Leaders. The list of Leaders in attendance is subject to change due to scheduling conflicts with the Conference.

WIE Lunch and Minisymposium
12:30 – 14:00
Grand Republic A
Registration required

The career choice of biomedical engineering and/or health informatics does not exist within a vacuum but rather must work in harmony with other aspects of our lives. Just as our careers are not static our lives outside of our careers are also not static. We have the potential to become partners, mothers, fathers, careers for our parents, grandparents for example and all of these roles mean that our work/life dynamic is constantly changing. A valuable session for anyone whether student or not, interested in learning more about Biomedical Engineering and Health Informatics as a career choice for women and men over a lifetime. Prominent women within the domains Biomedical Engineering and Health Informatics will present their real life case studies of living the journey through changing times in both career and family. Utilize the fantastic networking opportunity that will conclude this session to build and establish new professional networks with other women and men interested in your fields of expertise. Bring your contact details and be ready to make new contacts that are relevant for you

Did you know that joining IEEE Women In Engineering (WIE) is free for Students, Graduate Student Members and Life Members? (Dues are otherwise US$25 annually).

Registration in advance is required for the luncheon, as spaces are limited. Both men and women are encouraged to attend, and this event is open to non-students. Lastly, attendance at the symposium would be appreciated prior to partaking in the registered lunch.

Theme Keynote Lecture
On Computational Wings
14:00 -15:00
Location: Grand Republic B, C & D
Open to all registered conference attendees

Speaker: **Kenneth M. Ford,** Ph.D. Chief Executive Officer of the Florida Institute for Human & Machine Cognition (IHMC)

Theme Keynote Lecture
Network Neuroscience
14:00 -15:00
Location: Sorcerer's Apprentice Ballroom
Open to all registered conference attendees

Speaker: **Danielle Bassett,** Ph.D. Skirkanich Assistant Professor of Innovation, Department of Bioengineering, University of Pennsylvania

Symposium
Special Symposium: Point-Of-Care Technologies for Precision Medicine
13:30-15:00
Location: Ballroom of Americas
Open to all registered conference attendees

Chair:　　　　**Atam Dhawan,** PhD, NJIT

Speakers:

　　　　Tiffani Lash, PhD, National Institute of Biomedical Imaging and Bioengineering, NIH
　　　　Presentation Title: IH Perspective and Initiative to Promote POC Technologies for Precision Medicine

　　　　Julian Goldman, MD, Partners HealthCare and Massachusetts General Hospital
　　　　Presentation Title: Clinical Perspective on POC Technology Innovations for Improving Healthcare

　　　　Nicolas Chbat, PhD, Phillips Research North America
　　　　Presentation Title: An Industry Perspective on Achieving Precision Medicine for Point-of-care Technology in the ICU

Poster Session and Coffee Break
15:00 – 15:30
Location: Fantasia F, G & J
Open to all registered conference attendees

Ignite Sessions
15:30 – 17:00
Location: Main & Second Levels
Open to all registered conference attendees

PowerPoint/Poster Clinic Workshop: Tips on Effective Presentation Design and Delivery
15:30 – 17:00
Location: Pastoral 3
Open to all registered conference attendees

　　　　Are you nervous about your upcoming PowerPoint/Poster presentation, but have time for some last minute words of wisdom? For many of us, oral communication is the key for sharing ideas and research; however, both PowerPoint and Poster presentations offer visual tools which can make our talks infinitely more accessible, uncomplicated and effective. You will also receive some all-round pointers on the "do's" and "don'ts" of pre-paring and delivering an effective and even captivating presentation. Spaces are limited.

Poster Sessions
17:00 – 19:00
Location: Fantasia F, G & J
Open to all registered conference attendees

Networking II: Launching Your Professional Career
17:00 – 19:00
Location: Grand Republic C
Open to all registered conference attendees

Design Challenge Keynote
17:00 – 18:00
Location: Atlantic B
Open to all registered conference attendees

Young Professionals & Student Networking Reception
19:00 - 21:00
Location: Grand Republic A

>IEEE and EMBS want our young engineers to meet each other! Therefore, for the tenth year, we are hosting the IEEE Young Professionals & Student Networking Reception. Young Professionals are an IEEE entity whose programs work at providing benefits for young IEEE members after their 'Student Member' status has expired. If you are an IEEE Member who graduated with your first professional degree within the last ten years, including all graduate student members, you are automatically part of the Young Professionals group. Around the world, there are over 47,000 Young Professional members and 100 Young Professional Affinity Groups. The continuing goal of the Young Professionals group is to find out what students need from their Society at this particular stage of their careers and how their Society can in turn offer additional value of membership. If you are indeed a Young Professional, you are cordially invited to network with your peers, some of whom are working in industry, at the Reception's informal and brilliantly fun environment. Registration in advance is required, as spaces are limited. There is a small fee for attendance, but food and drinks are provided.

Industry Student Demo
19:00 - 21:00
Location: Grand Republic A
Registration for Young Professionals Reception required

Saturday, 20 August 2016

General Program

Oral Sessions
08:00-09:30
Location: Main & Second Levels
Open to all registered conference attendees

Personal Health Design Challenge-Tech Showcase
08:00 – 14:00
Location: Sorcerer's Apprentice 1 & 2
Open to all registered conference attendees

Personal Health Design Challenge-Continental Breakfast Session
08:30 – 09:30
Location: Sorcerer's Apprentice 3
Open to all registered conference attendees

Theme Keynote Lecture
To the Journey Ahead: From the Lab to the Market: Real life stories, lessons and reflections
09:45 -10:45
Location: Ballroom of Americas
Open to all registered conference attendees

Speaker: **Ram Fish,** MBA

Coffee Break
10:35 – 11:00
Location: Fantasia Foyer
Open to all registered conference attendees

Oral Sessions
11:00 -12:30
Location: Main & Second Levels
Open to all registered conference attendees

World Café Lunch Idea Exchange
12:30 – 14:00
Location: Sorcerer's Apprentice 3
Open to all registered conference attendees