Tutorials and Workshops

Half-Day Workshop
Biomedical and Health Informatics
8:30 - 12:30
Sapphire D
Registration Required

Organizer: May D. Wang (Georgia Institute of Technology and Emory University), Stephen T.C. Wong (Weill Cornell Medical College, Cornell University), and Mia K. Markey (University of Texas at Austin)

Speakers:
1. Lucila Ohno-Machado (University of California, San Diego)
2. Daniel L. Rubin (Stanford University)
3. Stephen T.C. Wong (Methodist Hospital Research Institute, Weill Cornell Medical College, Cornell University)
4. May D. Wang (Georgia Institute of Technology)
5. Mia K. Markey (University of Texas at Austin & Andersen Cancer Center)

Biomedical and health informatics is the interdisciplinary field that studies and pursues the effective uses of biomedical data, information, and knowledge for scientific inquiry, problem solving and decision making, motivated by efforts to improve human health. Biomedical informatics builds on computing, communication, and information sciences and technologies and their application in biomedicine.

Health Informatics is one of 14 Grand Challenges posted by National Academy of Engineering.

The purpose of this 1/2-day workshop is to highlight recent accomplishments in biomedical and health informatics through a series of scientific presentations by leading researchers, and to discuss the current and future directions of this fast growing research field.

Half-Day Workshop
Biomedical Engineering Revolutionizes Clinical Cardiology in the 21st Century
8:30 - 12:30
Sapphire E
Registration Required

Organizer: Kenji Sunagawa (Kyushu University)

Speakers:
1. Kenji Sunagawa (Kyushu University): Overview of the Current Therapeutic Strategy for Cardiovascular Diseases
2. Tetsuya Horai (Columbia University): The State-of-the-Art Artificial Hearts: What Can and Cannot be Done by the Latest Artificial Heart
3. Dimitrios Georgakopoulo (CVRx Inc.): Impact of Device Based Suppression of the Sympathetic System on the Cardiovascular Disorders
4. André Diedrich (Vanderbilt University): Smart Technologies for Patients with Autonomic Dysfunction
5. Masaru Sugimachi (National Cerebral and Cardiovascular Center, Japan): Vagal Modulation Saves Many

Even with tremendous advances in the understanding of the mechanisms and the pharmacological treatments, there remains a considerable subset of patients with incurable cardiovascular diseases. Chronic heart failure, one of such examples and the most end-stage diseases, continues to be a major medical and economical burden worldwide. There obviously need for more options for prolonging and improving life. Recent limitations in the development of newer drugs have motivated to develop devices for the treatment of such diseases. The most promising fields include modification of autonomic balance using implantable devices and ablation techniques, and artificial hearts capable of assisting the pump function and even being used as a destination therapy. It is impossible to exaggerate to say that only with BME the novel treatment would be possible and the clinical cardiology in the 21st century would be revolutionized. In this Workshop, we aimed at inspiring young scientists and engineers to engage themselves in developments of such world-saving devices, by having them know correctly the current clinical practice and the strong impact of these recent advancements in the near future.

This is a Workshop organized by Technical Committee on Cardiopulmonary Engineering.

Half-Day Workshop
Nanotechnology and Microtechnology for Medicine: Sensing, Drug Delivery,
Personalized Medicine, Micro and Nano Robotics
8:30 - 12:30
Sapphire 412
Registration Required

Organizer: Carmelina Ruggiero (University of Genoa)

Speakers:
1. Carmelina Ruggiero (University of Genova): Drug Delivery, Drug Design and Personalized Medicine
2. Mike McShane (Texas A&M University): Sensing and Possibly Drug Delivery and Personalized Medicine
3. Jay Nadeau (McGill University): Quantum Dots and Personalized Medicine
4. Hisataka Maruyama (Nagoya University): Micro and Nanorobotic for Biology and Medicine
5. Sheldon Moberg (Amgen): Nano Biotechnology Applications in Pharmaceutics Industries

Advances in genomics and proteomics are bringing about increasing capabilities to predict and prevent cellular dysfunctions and disease making it possible to identify individualized health features and disease likelihood.

This workshop focuses on tools and devices by which such advances are being achieved, on possible application in the pharmaceutics industry and on related future prospects. Some examples are given below.

Microfluidic devices achieved high throughput measurements detecting genetic mutation, infectious agents, post-translational modification, protein-DNA, protein -protein and protein ligand interactions.

Nanoparticle based tools allow improved diagnosis and personalized treatment of many complex diseases.

Semiconductor quantum dots allow for high throughput quantitative analysis of multiple biomarkers in cells and tissue. Nanofabricated layer by layer self-assembly sensors and carriers, based on polyelectrolyte assemblies embedding specific ligands allow for specific sensing and targeted drug delivery and controlled release.

Computer based analysis of quantitative structure activity relationship and docking plays a complementary role providing software tools for drug design.

Moreover, nano and micro robotics tools such as optical tweezers and micro fluidic chips can be used for the analysis and characterization of cell and viruses.

Half-Day Workshop
The MONARCA Project: a Multidisciplinary Solutions for Monitoring,
Treatment and Prediction of Bipolar Disorder
Episodes
8:30 - 12:30
Sapphire P
Registration Required

Organizer: Alessandro Puiatti (University of Applied Sciences and Arts of Southern Switzerland), Oscar Mayora (Tecnológico de Monterrey)

Speakers:
1. Alessandro Puiatti (University of Applied Sciences and Arts of Southern Switzerland, Manno, Switzerland): Welcome
2. Christian Haring (Psychiatric State Hospital of Tyrol, Innsbruck, Austria): The Bipolar Disorder
3. Oscar Mayora (CreateNet, Trento, Italy): Monitoring, Treatment and Prediction of Bipolar Disorder Episodes
4. Paul Lukowicz (University of Passau and Technical University of Kaiserslautern, Germany): Behavior Assessment and Forecasting for Patients Affected by Bipolar Disorder
5. Franz Gravenhorst, Amir Muaremi, Bert Arnrich (ETH, Zurich, Switzerland): Unobtrusive Electrodermal Activity Measurement Device and Voice Analysis for Supporting Bipolar Disorder Monitoring
6. Jakob Bardram (ITU, Copenhagen, Denmark): Patients and Self Assessment in Bipolar Disorder Therapy
7. Christian Haring (Psychiatric State Hospital of Tyrol, Innsbruck, Austria): The MONARCA System in Bipolar Disorder Clinical Trials 5.Masaru Sugimachi (National Cerebral and Cardiovascular Center, Japan): Vagal Modulation Saves Many

Bipolar Disorder, formerly known as manic depression, is a severe form of mental illness. It is characterized by alternated episodes of mania and depression, and it is treated typically with a combination of pharmacotherapy and psychotherapy. Recognizing early warning signs of upcoming phases of mania or depression would be of great help for a personalized medical treatment. Unfortunately, this is a difficult task to be performed for both patient and doctors.

In this workshop we present the research results coming from the MONARCA European project, which developed and validated solutions for multi-parametric, long term monitoring of behavioral and physiological information relevant to bipolar disorder. These solutions have been combined with an appropriate platform and a set of services into an innovative system for management, treatment, and self-treatment of the disease.

Starting from a deep understanding of the Bipolar Disorder and the challenges that this disease poses in its treatment, the workshop will present all the technological solutions that have been achieved in the MONARCA project in order to reach the envisioned goals. In particular, great emphases will be posed on all the innovative solutions that have been implemented in the project with a focused view on the biomedical aspects. The invited talks will be followed by a period of open discussion with the participants.

2nd IEEE EMBS Unconference on Rehabilitation Robotics Multiscale Modeling of the Nervous System
08:30 - 17:30
Sapphire Ballroom M
Registration Required

Organizers: Paolo Bonato (Spaulding Rehabilitation Hospital)
               Susan Fasoli (Providence VA Medical Center)
               Albert C. Lo, M.D., Ph.D (Brown University)
               James L. Patton, Ph.D. (The University of Illinois at Chicago)
               David Reinkensmeyer (University of California at Irvine)
               Giacomo Severini (Spaulding Rehabilitation Hospital)
               Carolee Winstein, PhD, PT, FAPTA (University of Southern California)
               William Aal (unConference.net)

The unconference format is relatively new to IEEE EMBS, although this format has been used by others to organize hundreds of meetings. We had the 1st IEEE EMBS Unconference in Boston in 2011 and it was a great success!!! The meeting in Boston was focused on wearable technology. This year, the topic of the meeting will be rehabilitation robotics. The format will be the same.

The purpose of the day is to bring together all those who care about addressing key challenges in the translation of robotic technology in rehabilitation. Attendees are expected to include clinicians, engineers and individuals from the private sector.

The unconference format is such that the agenda/schedule for the day is created live the day of the event. We will be working with leading experts in designing and facilitating unconferences to make sure that the 2nd IEEE EMBS Unconference on Rehabilitation Robotics is successful even more than its first edition. By creating the agenda the day of the event, we will facilitate discussions on emerging developments and new ideas in rehabilitation robotics. Bring your ideas, knowledge and enthusiasm to this event and you will get a lot out of it!!!

Full-Day Workshop
Multiscale Modeling of the Nervous System
08:30 - 17:30
Indigo 206
Registration Required

Organizer: Vasilis Marmarelis (University of Southern California)

Speakers: 1.   Theodore W. Berger (University of Southern California): Modeling of the Hippocampus
               2.   Kwabena Boahen (Stanford University): Large-Scale Neuromorphic Systems Simulation
               3.   Sam A. Deadwyler (Wake-Forest University): From Neural Ensemble Activity to Behavior
               4.   Mounya Elhilali (Johns Hopkins University): Multi-Scale Modeling of the Human Auditory System
               5.   Steven Fox (SUNY, New York): Modeling of the Theta Rhythm in the Hippocampus

6. Jack Gallant (University of California, Berkeley): Multi-Scale Modeling of the Human Visual System
7. Bill Lytton (SUNY Downstate Medical Center): Multi-Scale Modeling in the Brain: Embedding Strategies
8. Vasilis Z. Marmarelis (University of Southern California): Multi-Scale Neural Modeling
9. Mayank R. Mehta (University of California, Los Angeles): Multi-Scale Modeling and Representation of Neural Rhythms
10. Christoph E. Schreiner (University of California, San Francisco): Multi-Scale Modeling of the Auditory Cortex
11. James Schwaber (Jefferson University): Multi-Scale Modeling of the Autonomic Nervous System
12. Terry Sejnowski (Salk Institute): Multi-Scale Modeling in the Cerebral Cortex

This Workshop will bring together experts on the subject of "Multi-Scale Modeling in the Nervous System", which is attracting increasing attention worldwide because of its fundamental importance in understanding the hierarchical functional organization of the nervous system. This scientific discovery process has been accelerated by the recent availability of data from multi-electrode recordings and newly developed methodologies for the analysis/modeling of such data. Vast amounts of data are also currently accumulating from numerous molecular and behavioral/psychophysical studies of the nervous system conducted worldwide. Multi-electrode arrays are now chronically implanted in various parts of the brain by several research groups and provide a wealth of electrophysiological data previously unavailable. This has given impetus for the development of effective methodologies for the analysis of these vast databases in a manner that leads to increased scientific understanding of brain function at the multi-cellular level without simplifying the inherent complexity of the problem. Additional advances in data-collection techniques of molecular studies of neuronal function provide data and knowledge for a lower, finer-grain, "scale" in the hierarchical organization of the nervous system. Finally, advances at the behavioral/psychophysical level provide growing amounts of data and knowledge for a higher, coarser-grain, "scale" in the hierarchical organization of the nervous system. Obviously, the integration of these three levels of neural functional organization is a formidable task that is likely to occupy the rest of this century. However, the foundations of this effort are being laid at the present time and this Workshop aspires to contribute to this process.

The Workshop speakers will be asked to address the relations between at least two of these three levels and present their summary thoughts that pertain to the fundamental issues of multi-scale modeling of the nervous system (neuronal interconnectivity, emerging properties of neuronal ensembles etc.).

Full-Day Workshop
EEGLAB: An Open Software Environment for Electrophysiological Brain Imaging
08:30 - 17:30
Sapphire 400
Registration Required

Organizer: Zeynep Akalin Acar (University of California, San Diego)

Speakers:
1. Scott Makeig (University of California, San Diego): Ongoing Advances in Electrophysiological Brain Imaging
2. Arno Delorme (University of California, San Diego): Using the Three-Level Architecture of EEGLAB
3. Jason Palmer (University of California, San Diego): Independent Component Analysis (ICA) and Adaptive Multiple Mixture ICA (AMICA): Theory, Methods and Applications
4. Zeynep Akalin Acar (University of California, San Diego): Solving the EEG Forward Problem: A Neuroelectromagnetic Forward Head Modeling Toolbox (NFT) and Inverse Source Estimation Toolbox
5. Nima Bigdely-Shamlo (University of California, San Diego): A Measure Projection Toolbox (MPT) for Comparing EEG Dynamics across Subjects and Sessions
6. Tim Mullen (University of California, San Diego): A Source Information Flow Toolbox (SIFT) for Analysis of Oscillatory Dynamics of Effective Connectivity
7. Christian Kothe (University of California, San Diego): BCILAB: A Comprehensive Statistical Machine Learning and Brain-Computer Interface Toolbox

EEGLAB is a now very widely used, interactive Matlab toolbox for processing continuous and event-related EEG, MEG and other electrophysiological data incorporating independent component analysis (ICA), time/frequency analysis, artifact rejection, event-related statistics, and several useful modes of visualization of single-trial and averaged data. EEGLAB provides an interactive graphic user interface (GUI) allowing users to flexibly and interactively process their high-density EEG and other dynamic brain data using, in particular, independent component analysis (ICA) and/or time/frequency analysis and other methods. EEGLAB incorporates extensive tutorial and function help material, plus a command history function that eases users' transition from GUI-based data exploration to building and running batch or custom Matlab analysis scripts. EEGLAB offers a wealth of methods for visualizing and modeling event-related brain dynamics, both at the level of individual EEGLAB 'datasets' and/or across a collec-

tion of datasets brought together in an EEGLAB 'studyset.' For experienced Matlab users, EEGLAB offers a structured programming environment for storing, accessing, measuring, manipulating and visualizing event-related EEG data. For programmers and methods developers, EEGLAB offers an extensible, open-source platform through which they can share new methods with the world research community by publishing EEGLAB 'plug-in' functions that appear automatically in the EEGLAB menu of users who download them. In this workshop, we will review the EEGLAB structure for computer-competent users, and will then describe in more detail a set of advanced EEG data collection and processing tools recently developed and released at the Swartz Center for Computational Neuroscience (SCCN), UCSD, that connect to and extend the EEGLAB software environment. Together, these demonstrate that electrophysiological data analysis should now be regarded and applied as a human cortical functional brain imaging modality with near ms-scale time resolution and cm-scale spatial resolution.

Full-Day Workshop
OCT Imaging of the Eye
08:30 - 17:30
Sapphire 410
Registration Required

Organizer: Shuliang Jiao (University of Southern California)

Speakers: 1. Joseph A. Izatt (Duke University): OCT Guidance of Ophthalmic Surgery and OCT Image Processing
                    2. Christoph K. Hitzenberger (Medical University of Vienna): Polarization-sensitive OCT Imaging of the Eye
                    3. Ruikang K Wang (University of Washington): OCT Imaging of Retinal Blood Flow
                    4. Srinivas R. Sadda (University of Southern California): OCT Imaging of Retinal Diseases
                    5. Shuliang Jiao (University of Southern California): Multimodal Imaging of the Eye

Optical coherence tomography (OCT) is a low-coherence interferometer-based noninvasive non-contact medical imaging modality that can provide high-resolution cross sectional images of biological tissues. OCT is one of the most active research fields in biomedical optical imaging. Since it was first invented in 1991 OCT has been becoming the new standard for in vivo non-invasive ophthalmic imaging and has been widely used for diagnosis and treatment monitoring of various ocular diseases like age-related macular degeneration, diabetic retinopathy, and glaucoma. By utilizing the rich contrasts provided by the light field, OCT has also branched into several exciting new imaging areas for structural and functional imaging. By using the Doppler effect OCT is able to image the retinal blood flow at an unprecedented level. By using the polarization effect polarization-sensitive OCT is able to reveal the specific features of the retinal nerve fiber layer (RNFL) and the layer of the retinal pigment epithelium (RPE). OCT can also be integrated into multimodal imaging system for the comprehensive diagnosis of retinal diseases. Using OCT to guide ophthalmic surgery in the operation room is another new exciting application of the technology. The workshop will bring experts of all these exciting areas of OCT to give us a review of the current status and perspectives of the different branches of the technology and their applications.

Full-Day Workshop
Software Tools for Image Based Modeling, Simulation, and Visualization
08:30 - 17:30
Sapphire A
Registration Required

Organizer: Rob MacLeod (Center for Integrative Biomedical Computing (CIBC) SCI Institute, University of Utah, and Dana Brooks, Dept. of Electrical and Computer Engineering, Northeastern University)

Speakers: 1. Dana Brooks (Northeastern University): Strategies for Effective Image Segmentation and Seg3D
                    2. Jess Tate and Darrell Swenson (University of Utah): Seg3D Demo and Tutorial.
                    3. Tom Fogal (Saarland University): Visualization of Large Scale Image Data and ImageVis3D
                    4. Tom Fogal (Saarland University): ImageVis3D Demo and Tutorial
                    5. Rob MacLeod (University of Utah): Case Study: Image Based Analysis of Patients with Atrial Fibrillation
                    6. Darrell Swenson (University of Utah): Mesh Generation Methods and BioMesh3D
                    7. Darrell Swenson & Brett Burton (University of Utah): BioMesh3D Demo and Tutorial
                    8. Dana Brooks& Moritz Dannhauer (Northeastern University): Integration Problem Solving Environments and SCIRun

The goal of this tutorial is to introduce participants to a suite of software tools for image-based modeling, simulation, and visualization developed by the NIH/NCRR Center for Integrative Biomedical Computing (CIBC). This

portable flexible collection of interactive tools was designed in particular to support the development of subject specific, image based geometric models for simulation of bioelectric fields, but suite as well as its individual components have been applied to a wider set of problems. The tools in the suite are: ImageVis3D, for visualization of large scale data; Seg3D, for general purpose user-guided image segmentation; BioMesh3D, a set of utilities for creating surface and volume meshes from segmented image data; map3d, for visualization of surface based maps from multichannel time signals; and SCIRun, a comprehensive problem solving environment that integrates many of the capabilities of an entire image based modeling pipeline.

The tutorial will be a mix of didactic presentations on the component steps of image based modeling, simulation, and visualization; hands on practice with the software, and cases studies on real world applications.

We will provide participants with the software and test data sets and encourage participants to bring their laptop computers, and if relevant their own data as well. CIBC staff and developers will be on hand to help participants learn the programs, port their data, and generate useful results. We especially encourage participation by students, post docs, and technical users and software developers.

Full-Day Workshop
Brain Dynamics in Human Motor Control
08:30 - 17:30
Sapphire H
Registration Required

Organizer: David Peterson (University of California, San Diego)

Speakers:
1. Jose Carmena (University of California, Berkeley): Corticostriatal Plasticity is Necessary for Learning Intentional Neuroprosthetic Skills
2. Gert Cauwenberghs (University of California, San Diego): Large-Scale Neuromorphic Silicon Models of Cortical Sensorimotor Systems
3. Todd Coleman (University of California, San Diego): Dynamics of Information Transfer in the Motor Cortex during Reaching Task
4. Eberhard Fetz (University of Washington): Bidirectional Interactions between the Brain and Implantable Computers
5. Scott Makeig (University of California, San Diego): Mobile Brain/Body Imaging
6. David Peterson (University of California, San Diego): Dynamic Hierarchies in Nested Loops of the Basal Ganglia
7. Howard Poizner (University of California, San Diego): New Strategies for Studying Complex Human Behavior in Health and Disease
8. Terry Sejnowski (Salk Institute): A New Power Law for Curved Arm Movements

Human motor control is impaired in a wide variety of neurologic disorders, from Lou Gehrig's (ALS) to Parkinson's disease. Despite intensive efforts in basic and clinical research, treatments remain incomplete and mostly symptomatic. Initiatives in biomedical engineering are opening two major new avenues to dramatically improve the options available to these patients. First, brain machine interfaces (BMI) are increasingly incorporating closed-loop and learning mechanisms. These advances promise to endow the systems with richer functionality and greater adaptability to the individual patient. Second, our mechanistic understanding of how the brain controls the motor apparatus is at the cusp of rapid advances. Mobile brain imaging, virtual reality, biologically realistic models of the brain's motor control circuits, and neuromorphic implementations of those models are providing new means of measuring and modeling dynamics of the large scale brain networks involved in motor control. Importantly, advances in these two enterprises are synergistic: BMIs are informing our knowledge of the brain dynamics of volitional motor control, and basic research on the brain dynamics of motor control provides clues about how to optimize BMIs. In this workshop, participants will receive 1) background on the brain systems involved in motor control and the technologies used to interface with and investigate them, 2) current trends in BMIs and basic research into large-scale brain dynamics involved in human motor control, 3) discussion of anticipated future developments in these areas of research, and 4) current and future clinical implications. Talks will assume no prior knowledge of the biology, technology, and clinical conditions, but will also include substantial advanced material for experts in the field. Talks will be interleaved with generous time for interactive discussions.

Full-Day Workshop
Flexible Neurosurgical Robotics
08:30 - 17:30
Sapphire H
Registration Required

Organizer: Cameron N. Riviere (Carnegie Mellon University), Ferdinando Rodriguez y Baena (Imperial College),
Jonathan A. Engh (University of Pittsburgh Medical Center)

Speakers:
1. Jaydev P. Desai (University of Maryland): Progress towards the Development of a MRI-Compatible Minimally Invasive Neurosurgical Intracranial Robot (MINIR)
2. Pierre E. Dupont (Harvard Medical School): Minimizing Collateral Damage in Neurosurgery Using Continuum Robots
3. Gabor Kosa (Tel Aviv University): Swimming Microrobot and Flexible Actuator for Neurosurgery
4. Francis M. Creighton IV (Pulse Therapeutics, Inc.): Flexible Magnetic Neurosurgery: Commercial and Clinical Lessons from the Stereotaxis Experience
5. Michael Y. Oh (Allegheny General Hospital): Neurosurgical Robots: What's Gone Wrong So Far
6. Johnathan A. Engh, M.D. (University of Pittsburgh): Clinical Challenges and Potential Applications of Flexible Neurosurgical Robotics
7. Ferdinando Rodriguez y Baena (Imperial College, University of London): Advances in Keyhole Neurosurgery with a Steerable Probe Inspired by Nature
8. Cameron N. Riviere (Carnegie-Mellon University): Steering of Flexible Needles via Duty-Cycled Rotation for Neurosurgery

Minimally invasive approaches to neurosurgery have so far been limited by the lack of suitable instrumentation. The minimally invasive approach increases the challenges of a surgical procedure in terms of safety and accuracy. The rigid endoscopic tools that have seen use in the brain so far severely limit the surgeon's options in planning the necessary access for a procedure. The lack of versatility of existing instrumentation has motivated numerous efforts to develop flexible or non-rigid robotic systems that have the potential to simultaneously improve ease of use, accuracy of manipulation, and capability to conform access trajectories to the geometry of the brain, thus maximizing the safety of brain access.

Several research groups worldwide have published research toward flexible robotics for neurosurgery, but these efforts are widely scattered geographically, and to date there has been no single event to gather researchers from these groups for cross-pollination of research ideas. In this workshop, leading researchers in flexible neurosurgical robotics will present their latest results. In addition, there will be clinical presentations from practicing neurosurgeons, describing the need for such systems, the challenges with which they are faced, and their future potential.

Full-Day Workshop
Human-Centered Systems Engineering - Human Factors from Lust to Dust
08:30 - 17:30
Sapphire L
Registration Required

Organizer: George Samaras (Samaras & Associates, Inc.)

Products, processes, and services exist solely because their uses by humans have real or perceived value (utilitarian or esthetic). This is the fundamental justification and rationale for human-centered development, which provides the greatest long-term return-on-investment and lowest "total cost of ownership".

Systems Engineering (SE) is a structured, systematic approach to the conceptualization, design, development, deployment, and replacement of products, processes, and services. Classical SE, in existence since the early 1900s, is one of the oldest agile methods. We will discuss the fundamental state space, lifecycle, technical, and management activities, in the context of micro-ergonomics (tools for individuals) and macro-ergonomics (tools for organizations).

Quality is about identifying and satisficing ALL the stakeholders' evolving and frequently conflicting needs, wants, and desires (NWDs). Requirements (design inputs) are a subset of NWDs selected for fulfillment. Modern human factors engineering can contribute at all levels of SE. The concept of human-centered system complexity (from physical and behavioral to social and cultural considerations) will be presented, followed by a detailed discussion of the relevant metrology.

Human-centered SE presents a rather large set of factors for experimental verification and validation studies. Experimental design approaches, historically used by engineers, are very inefficient given large numbers of factors. We will discuss the fundamental principles of experimental designs and modern approaches (e.g., statistical design of experiments or DOE) useful for product, process, and/or service verification and validation studies. DOE will be visually presented using its underlying, simple geometric structure.

Half-Day Tutorial-CANCELLED
Medical Device Connectivity to Health Information Technology and Its Use in Clinical Analysis and Modeling
08:30-12:30
Aqua 306B
Registration Required

Organizer: John R. Zaleski (Nuvon, Inc.)

Speakers:
1. John Zaleski, PhD, CPHIMS, CTO & VP Clinical Applications, Nuvon, Inc.
2. Elliot Sloane, PhD, CCE, FHIMSS, President, Center for Healthcare Information Research and Policy

The evolution of electronic health records and the Federal guidance and direction on the meaning of "Meaningful Use" of healthcare information technology, as well as the Recovery Act have motivated the need for more seamless integration of information within the long term clinical records of patients. Further, the importance of error reduction vis a vis the 1999 Institute of Medicine (IOM) report "To Err Is Human" has placed a more directed focus on those areas within the healthcare enterprise that can be more efficiently automated to reduce errors, ensure richer, more complete data collection, and provide a stepping off point for more robust clinical research and clinical decision making. Hence, more attention is being paid to medical devices, their uses at the point of care, and the data they produce as part of the overall care and management of patients. These items motivate the need to better educate and inform the clinical staff as well as engineers in vendor organizations whose primary object is the creation of medical devices or their use at the point of care and how their data can be used to bring better clinical value to the clinician.

Half-Day Tutorial
Health Informatics: Applications, Requirements, and Emerging Research
08:30-12:30
Aqua 306A
Registration Required

Organizer: Upkar Varshney (Georgia State University)

Health Informatics is the intersection of several fields including computer science, healthcare, and business. The health informatics have to deal with many challenges such as the need to provide the needed information anywhere anytime to anyone authorized in prompt, correct and secure ways. Using this broad definition, HI could include resources, devices and methods including (a) electronic medical records, (b) decision support systems for healthcare, (c) health information systems, (d) protocols for exchange of medical and healthcare information, and, (e) devices for medical decisions. The health informatics can be divided into multiple sub-areas such as consumer health informatics, nursing health informatics, organizational health informatics, public health informatics, and clinical or medical health informatics, each serving a specialized role to specific sub-population.

In this tutorial, we address how information can be used most effectively in various healthcare processes to achieve several goals. More specifically, we look at the followings:

- Mobile EMR/EHR: how information related to patients is organized and used in the delivery of healthcare
- Mobile Health monitoring: how the current information on patient's condition is used in providing the needed care in a timely fashion
- Medication adherence: how the information on patient's medication taking behavior can be used in deciding the most suitable intervention to improve adherence
- Medical decision making: how the presentation of information can be improved to achieve improved medical decision making
- Mobile technologies for elderly: how information and communications technologies can be matched to elderly in their desire for independent living

- Mobile Infrastructure design: how different requirements of health informatics can be utilized in the design/implementation of infrastructure.

Half-Day Tutorial
g.tec Brain-Computer Interface and ECoG Workshop
13:30-17:30
Sapphire E
Registration Required

Organizer:	Robert Prueckl (g.tec Guger Technologies OG)

Speakers:
1. Gerwin Shalk (Wadsworth Center, NYS Dept. of Health)
2. Deniz Erdogmus (Department of ECE, Northeastern University)
3. J. Adam Wilson (University of Cincinnati College of Medicine)
4. Robert Prückl(g.tec Guger Technologies OG)

A Brain-Computer Interface (BCI) can be realized with EEG, ECoG or spike activity recorded from the brain. BCI research is one of the most fascinating fields in neuroscience. Mental tasks or focused attention lead to changes in the brain's activity patterns which can be measured, analyzed and classified. The transformation of these changes into a control signal allows to communicate or to control external devices just by thinking - an amazing technology with the potential to help patients who are about to lose any other way to interact with their environment. Moreover state-of-the-are research uses signals from the human motor cortex to reconstruct movement trajectories of limbs or brain mapping is performed for surgical preparation in clinical settings.

This workshop informs about the major methodological approaches, technical issues, application examples, opportunities and limitations, current trends in BCI research and much more.

Intended audience: This workshop is intended for people interested in learning the new skill of BCI communication and for people who are interested in combining BCI technology into their field of expertise. The workshop contains material about human computer interaction, biosignal analysis in off-line and real-time mode, rehabilitation, biomedical and electrical engineering, computer science and Virtual Reality.

Half-Day Tutorial
Modeling E-Health Processes by the Unified Modeling Language
13:30-17:30
Sapphire D
Registration Required

Organizer:	Simona Ferrante (Politecnico di Milano), Francesco Pinciroli (Politecnico di Milano), Sara Marceglia (Politecnico di Milano), Stefano Bonacina (Politecnico di Milano)

Speakers:
1. Simona Ferrante (Politecnico di Milano)
2. Bonacina Stefano (Politecnico di Milano)

Given the dimension and difficulty of data managing in e-Health, and the complexity of multidisciplinary Healthcare processes, the "Unified Modeling Language" (UML) has become an essential tool to properly model the domain of interest. It is a language for specifying, visualizing, constructing, and documenting the artifacts of software systems, as well as for business or process modeling. The strength of the UML language is its simple graphical notation that facilitates the communication between informatics and experts of the domain. This is a crucial requirement to simplify, verify and optimize the development of the model.

The UML allows applying systematically the novel process knowledge coming from the experience of healthcare professionals achieving at least a detailed explanation of the process useful for all the involved actors. When the process is already well organized the UML model can provide a way towards standardization.

As the UML was developed to design and specify software systems, process modeling using UML could facilitate the evolutionary maintenance of health information systems. The UML model of a process can help during the design phase of new components.

The aim of this tutorial is to give a permanent idea of the language to students and researchers interested and involved in healthcare applications that have the necessity to learn a systematic and rational approach to health care processes. The tutorial can be delivered in a half a day format including the first two hours of UML fundamentals, using examples coming from the e-Health domain, and the conclusive 2 hours on the application of UML in the domain of the rehabilitation of individuals with stroke inpatients in a specialized clinic.

Half-Day Tutorial
IEEE11073 Personal Health Devices Educational Session
13:30-17:30
Aqua 306B
Registration Required

Organizer: Malcolm Clarke (Brunel University)

The session will present a tutorial on the IEEE 11073 Personal Health Device (PHD) standards. The session will cover the theory of the 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.

Half-Day Tutorial
The Role of Medical Imaging Informatics in Research & Healthcare
13:30-17:30
Aqua 306A
Registration Required

Organizer: Brent J. Liu (University of Southern California)

Speakers: 1.   Brent J. Liu (University of Southern California)
               2.   Han K. Huang (University of Southern California)
               3.   Heinz Lemke (Innovation Center for Computer Assisted Surgery , University of Leipzig)

Nearly in all clinical medicine specialties, medical images and other multi-media related data are generated and need to be distributed to points of decision. Recently, the electronic patient record (ePR) with image distribution system is gradually taking over as the method for distribution of multi-media content to the clinical environment. New challenges are accompanying its spread into other clinical fields. Particularly important are the modeling and analysis of workflow of the affected clinical disciplines as well as interface and integration issues with the image-connected electronic patient record. Although the awareness of these issues is increasing rapidly, equally important is the recognition in the professional community that more rigorous scientific methods are needed to handle the clinical system development and deployment. Furthermore, medical imaging informatics is not only based on many existing concepts, theories, terminology, and methodology derived from health informatics, but also deals with different types of data including multi-dimensional medical images, graphics, waveforms, graphics and text which are focused on the cellular, tissue, and organ systems. Accordingly, medical imaging informatics requires new concepts and new tool sets to handle these types of data. This half-day tutorial aims to first introduce the basic concepts of Medical Imaging Informatics infrastructure in both research and clinical environments including PACS, RIS, HIS, ePR, standards, databases, and system integration. This will be followed with discussions of new frontier areas of research in medical imaging informatics with some examples of clinical applications in Surgery, Neurology, Oncology, and Neuro-Rehabilitation.

General Program

Oral Sessions
Sapphire, Cobolt, Aqua & Indigo Levels
08:00 - 09:30
Open to all registered conference attendees

Student Paper Competition Session I
Sapphire Green Room
08:00 – 09:30
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 at 10:45am before the Plenary session on Friday in the Sapphire Ballroom.

PowerPoint/Poster Clinic: Effective Presentation Design and Delivery
Indigo 206
08:00 – 09:30
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 preparing and delivering an effective and even captivating presentation. Spaces are limited.

Theme Keynote Lecture
Advanced Drug Delivery for the 21st Century: Opportunities and Challenges
08:15 - 09:15
Sapphire Ballroom
Open to all registered conference attendees

Speaker: Hamid Ghandehari, Ph.D. - Professor of Bioengineering and Pharmaceutics, Director, Utah Center for Nano medicine, Co-Director, Nano Institute of Utah, University of Utah, Salt Lake City, Utah

Exhibits
Visit the exhibits located on the Indigo Level, Indigo Ballroom
09:00 - 17:00
Open to all registered conference attendees

Poster Session and Coffee Break
Located on the Indigo Level, Indigo Ballroom
09:30 - 11:00
Open to all registered conference attendees

EMBC'12 Opening Remarks & Welcome
11:00 - 11:30
Sapphire Ballroom
Open to all registered conference attendees

Speaker: Zhi-Pei Liang - 2012 EMBS President

Keynote Lecture
Uncommon Sense or Common Non-sense: Great ideas that would never work
11:30 - 12:30
Sapphire Ballroom
Open to all registered conference attendees

Speaker: William R. Brody, Ph.D., M.D - President of the Salk Institute

Cash Concession for Lunch (food and beverages)
12:00 - 14:00
We are pleased to offer a cash concession menu that will be located on Sapphire level foyer to include sandwiches, salads, cookies and beverages.

Lunch with Leaders SOLD OUT
12:30 – 13:30
Indigo 204
Registration required

Organizer: Iris Yan - The Pennsylvania State University

Hungry for a chat? All EMBS students are invited to register to one (of three) free lunches at the EMBC'12. 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.

Student Paper Competition Session II
Sapphire Green Room
13:30-15:00
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 at 10:45am before the Plenary session on Friday in the Sapphire Ballroom.

Oral Sessions
Sapphire, Cobalt, Aqua & Indigo Levels
13:30- 15:00
Open to all registered conference attendees

Poster Session and Coffee Break
Located on the Indigo Level, Indigo Ballroom
15:00 – 16:30
Open to all registered conference attendees

Theme Keynote Lecture
Reproducibility in Modeling: Technology for the Stepping Stones of Science
15:30-16:30
Sapphire Ballroom
Open to all registered conference attendees

Speaker: James B. Bassingthwaighte, M.D., Ph.D- Professor of Bioengineering and Radiology, University of Washington

Student Paper Competition Session III
Sapphire Green Room
16:30-18:00
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 at 10:45am before the Plenary session on Friday in the Sapphire Ballroom.

Oral Sessions
Sapphire, Cobalt, Aqua & Indigo Levels
16:30 - 18:00
Open to all registered conference attendees

Theme Keynote Lecture
Bioengineering: The Bridge between Biology and Orthopaedic Sports Medicine
16:45-17:45
Sapphire Ballroom
Open to all registered conference attendees

Speaker: Savio L-Y. Woo, Ph.D., D.Sc.(Hon), D.Eng.(Hon)- Distinguished University Professor and Director Musculoskeletal Research Center, Department of Bioengineering, Swanson School of Engineering, University of Pittsburgh

Student Chapter/Club Development-Meet and Become Leaders
Indigo 206
18:00 – 19:30
Open to all registered conference attendees

The goal here is to share examples of how Student Chapters and Clubs have been developed in different places around the world, and to provide immediate answers to novice questions from people who have actually done the work very recently. Experienced Chapter Leaders will act as panellists for a Q&A session, including last year's Best Chapter/Club Award Winners, recent Winners, and a Student Chapter Faculty Adviser. All levels of interest are welcome for avid volunteers; i.e., you don't have to want to change the world – just a small piece of it!.

Attendee & Student Welcome Reception
19:30 - 21:30
Bayfront Park-Hilton
Registration required - Guests of students 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 Hor' D Oeuvres.

General Program

Oral Sessions
Sapphire, Cobalt, Aqua & Indigo Levels
08:00 - 09:30

Special Session
Panel Discussion: Opportunities for Biomedical Engineers within the Pharmaceutical Industry
08:00-09:30
Cobalt 520
Open to all registered conference attendees

Special Demo Workshop
Realizing Effective Wireless Sensing Solutions - From Concept to Delivery (Sponsored by Shimmer Research)
08:00-09:30
Aqua 306B
Open to all registered conference attendees

Chair:	Tom McMahon
Co-Chair:	Benjamin Kuris

This session will be of interest to biomedical researchers and students interested in wearable sensing and signal processing. Shimmer is an extensible and open source sensor platform for physiological and kinematic data collection in over 50 countries.

During the workshop you will hear from Shimmer Research partners both from a commercial and a research standpoint on the delivery of robust and fit for purpose sensing solutions across a range of application areas. A live demonstration of building and customizing an application will be given.

Shimmer research is committed to the advancement of body worn sensing based on open source principles and it is in this vein that it will also be presenting some what it is on its technological road map for the coming year. We will discuss the various ways to work with the platform as well as the new tools available from Shimmer for developers.

Theme Keynote Lecture
Bioengineering: The Bridge between Biology and Orthopaedic Sports Medicine
08:15-09:15
Sapphire Ballroom
Open to all registered conference attendees

Speaker: John A. Rogers, Ph.D- Lee J. Flory-Founder Chair in Engineering, University of Illinois at Urbana-Champaign

Exhibits
Visit the exhibits located on the Indigo Level, Indigo Ballroom
09:00 - 17:00
Open to all registered conference attendees

Poster Session and Coffee Break
Located on the Indigo Level, Indigo Ballroom
09:30 - 11:00
Open to all registered conference attendees

Meet the Editors of EMBS Publications
Indigo 204
09:30-11:00
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.

Keynote Lecture
Digitizing Human Beings: A New Medicine
11:00-12:00
Sapphire Ballroom
Open to all registered conference attendees

Speaker: Eric J. Topol, M.D.- Director of the Scripps Translational Science Institute, and Vice-Chairman of the West Wireless Health Institute

Cash Concession for Lunch (food and beverages)
12:00 - 14:00
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Lunch with Leaders SOLD OUT
12:00 – 13:30
Indigo 204
Registration required

Organizer: Iris Yan - The Pennsylvania State University

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Special Session-William Casebeer-The DARPA Young Faculty Awards (YFA) Program
12:00-1:30
Sapphire 400
Open to all registered conference attendees

Chair: Nitish Thakor- John Hopkins University

Oral Sessions
Sapphire, Cobalt, Aqua & Indigo Levels
13:30-15:00
Open to all registered conference attendees

Special Session
Panel Discussion: Biomedical Engineering Education and Curriculum -
Novel Approaches to BME for Global Education in Latin America
13:30-15:00
Cobalt 520
Open to all registered conference attendees

Technical Writing and Manuscript Preparation
13:30-15:00
Indigo 206
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.

Poster Session and Coffee Break
Located on the Indigo Level, Indigo Ballroom
15:00-16:30
Open to all registered conference attendees

Theme Keynote Lecture
Cellular and Molecular Image Analysis
15:30-16:30
Sapphire Ballroom
Open to all registered conference attendees

Speaker: Erik Meijering, Ph.D.- Associate Professor of Bioimage Analysis, Erasmus University Medical Center, Rotterdam, Netherlands

Oral Sessions
Sapphire, Cobalt, Aqua & Indigo Levels
16:30-18:00
Open to all registered conference attendees

Special Session
Biomedical Engineering Education and Curriculum - Novel Approaches to BME for Global Education
16:30-18:00
Cobalt 520
Open to all registered conference attendees

Theme Keynote Lecture
Transforming Health Care with Biomedical Engineering: Model-Based Approaches
16:45-17:45
Sapphire Ballroom
Open to all registered conference attendees

Speaker: Misha Pavel, Ph.D.- Program Director, National Science Foundation

General Program

Oral Sessions
Sapphire, Cobalt, Aqua & Indigo Levels
08:00-09:30
Open to all registered conference attendees

Special Session
Panel Discussion: Biomedical Technology in Global Health - Integration of New Technologies in Diabetes Care
08:00-09:30
Cobalt 520
Open to all registered conference attendees

Theme Keynote Lecture
Technical Innovation in Mechanical Ventilation
08:15-09:15
Sapphire Ballroom
Open to all registered conference attendees

Speaker: Michael B. Duich- Senior Director, Research & Development, Philips Healthcare / Hospital Respiratory Care

Exhibits
Visit the exhibits located on the Indigo Level, Indigo Ballroom
09:00 - 17:00
Open to all registered conference attendees

Poster Session and Coffee Break
Located on the Indigo Level, Indigo Ballroom
09:30-11:00
Open to all registered conference attendees

Keynote Lecture
Emerging Medical Device Technologies: Creating Better Healthcare Solutions for Chronic Disease Management
11:05-12:00
Sapphire Ballroom
Open to all registered conference attendees

Speaker: Rebecca Bergman- Vice President, Research & Technology, Cardiac Rhythm Disease Management, Medtronic, Inc.

Cash Concession for Lunch (food and beverages)
12:00 - 14:00
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Lunch with Leaders SOLD OUT
12:00 – 13:30
Indigo 204
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WIE Lunch and Minisymposium
Women in Biomedical Engineering and Health Informatics: A Lifetime Journey Integrating Diversity
12:00 – 13:30
Indigo 202
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, carers 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. Utilise 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.

Oral Sessions
Sapphire, Cobalt, Aqua & Indigo Levels
13:30-15:00
Open to all registered conference attendees

Poster Session and Coffee Break
Located on the Indigo Level, Indigo Ballroom
15:00-16:30
Open to all registered conference attendees

Undergraduate Research/Design Poster Session
Located on the Indigo Level, Indigo Ballroom
15:00-16:30
Open to all registered conference attendees

This is the first of an ongoing series of forums within the annual Engineering in Medicine and Biology Conference in which undergraduate bioengineering research and/or design work can be presented within a friendly and supportive environment. If you are an undergraduate student, this session provides you with the unique opportunity to showcase a research or design project you have worked on to leaders in the BME field, and to network with graduate students and potential faculty mentors. First (corresponding) authors must be registered in an undergraduate program in bioengineering or other engineering field in the academic year immediately prior to, or during, EMBC'12

Theme Keynote Lecture
Toward High-Performance Clinically Viable Brain-Machine Interfaces
15:30-16:30
Sapphire Ballroom
Open to all registered conference attendees

Speaker: Krishna V. Shenoy, Ph.D.- Professor of Electrical Engineering, Bioengineering and Neurobiology, Stanford University

Oral Sessions
Sapphire, Cobalt, Aqua & Indigo Levels
16:30-18:00
Open to all registered conference attendees

Theme Keynote Lecture
Engineering: the sine qua non for Systems Biology and Medicine
16:45-17:45
Sapphire Ballroom
Open to all registered conference attendees

Speaker: Shankar Subramaniam, Ph.D.- Professor of Bioengineering, Chemistry and Biochemistry, Cellular and Molecular Medicine and Nano Engineering, and Bioengineering Department Chair, University of California at San Diego

Career Advice: Short-Term, Long-Term and Everything In-Between
Cobalt 500
18:00-19:30
Open to all registered conference attendees

Are you wondering what to do next in your career? We have assembled a panel of diverse and prestigious speakers to provide their insight on the job market today – with representation from academia, the private sector, government and regulators/funders. The discussion will be moderated and the session will focus on pragmatic advice for today, intermingled with future trends and tips for the future.

GOLD & Student Networking Reception
19:30 - 21:30
Indigo Terrace

IEEE and EMBS want our young engineers to meet each other! Therefore, for the seventh year, we are hosting the IEEE EMBS-GOLD & Student Networking Reception. GOLD, or Graduates Of the Last Decade, is 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 IEEE GOLD. Around the world, there are over 47,000 GOLD members and 100 GOLD Affinity Groups. The continuing goal of GOLD 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 GOLD, 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 drink are provided.

General Program

Oral Sessions
Sapphire, Cobalt, Aqua & Indigo Levels
08:00 - 9:30
Open to all registered conference attendees

Special Session
**Panel Discussion: A New Outlook for Pediatric Medical Devices? -
Incentives, Challenges and the Roles of Academic
Medical Centers**
08:00-09:30
Sapphire 411
Open to all registered conference attendees

Special Keynote Lecture
Role of Fluid Mechanics and MicroRNA in Endothelial Regulation
09:45-10:45
Sapphire Ballroom
Open to all registered conference attendees

Speaker: Shu Chien, M.D., Ph.D.- Y.C. Fung Professor of Bioengineering and Medicine, & Director, Institute of Engineering in Medicine, University of California San Diego

Oral Sessions
Sapphire, Cobalt, Aqua & Indigo Levels
11:00-12:30
Open to all registered conference attendees

Special Session
Panel Discussion: The Role of Wireless Medical Technology in Global Health
11:00-12:30
Sapphire 411
Open to all registered conference attendees