2012 5th International Conference on Biomedical Engineering and Informatics

BMEI 2012

16-18 October 2012,
CQUPT, Chongqing, China

Editors:
Qianbin Chen
Jun (Luke) Huan
Yong Xu
Tianqi Zhang
Lipo Wang

Preface

BMEI 2012

Biomedical engineering and informatics aims at providing hardware and software support for biomedical research. Various genome projects have contributed to an exponential growth in DNA and protein sequence databases. Advances in imaging and high-throughput technology, such as high throughput sequencing and mass spectrometry, have enabled the study of many biomedical problems at the genomic and molecular level. Many novel biomedical devices and instruments are being developed or invented to save healthcare cost, improve quality of life, and save lives. In particular, we see fast growth of the following areas in biomedical engineering and informatics:

- Genomics: High throughput sequencing and genome-wide association studies are clearly on the horizon. Data analysis in high throughput sequencing, including Hi-Seq, RNA-seq, ChIP-Seq among others, requires advanced computing capability to be able to store, transfer, process, and visualize terabytes of data.
- Proteomics is a fundamental component of on aging, human development, and many other research endeavors. Protein identification and quantitative analyses of protein levels, as well as functional analyses and integration of protein interactomes in cells require intensive informatics input.
- Metabolomics is an emerging area that requires informatics input in data analysis and linkage mapping of metabolic products to cell function.
- Chemical Biology and Drug Discovery. Needs here are data analysis and modeling for chemical probe discovery, high throughput screening, and high content screening, including screening data management, chemical structure activity modeling, docking, image analysis, chemical library design and search.
- Bio-Imaging. Needs here are from a wide range of research topics, including biomedical imaging and cancer diagnostics.
- Bio-text Mining and Semantics Technologies. Needs here are from health informatics where semantics and text mining are essential for electronic health records processing.
- Biomedical devices, sensors and instruments for health information management, wearable or wireless health monitoring, implantable applications, point-of-care diagnosis, rehabilitation, assisted-living and home care, and others.

BMEI 2012 is a premier international forum for scientists and researchers to present the state-of-the-art of multimedia, signal processing, biomedical engineering and informatics and to discuss future research challenges. BMEI 2012 is technically co-sponsored by the IEEE Engineering in Medicine and Biology Society.

This year we received a large number of submissions. Each paper was reviewed rigorously by typically three or four reviewers. We want to thank all the authors, program committee members, external reviewers, local conference organizers for their hard work to make BMEI 2012 yet another year of success.

Keynote Lectures

Bruce C. Wheeler
University of Florida

Bruce Wheeler is Professor and Interim Chair of the Pruitt Family Department of Biomedical Engineering at the University of Florida. From 1980 to 2008 he was with the University of Illinois at Urbana-Champaign, most recently as Professor and Founding and Interim Department Head of the Bioengineering Department. He was also a Professor of Electrical and Computer Engineering and the Beckman Institute, a former Associate Head of ECE, and a former chair of the Neuroscience Program.

He is the incoming President Elect of the IEEE Engineering in Medicine and Biology Society and has been the Editor in Chief of the IEEE Transactions on Biomedical Engineering since 2007. He is a Fellow of the IEEE and AIMBE.

He received the B.S. degree from MIT and later the M.S. and Ph.D. in Electrical Engineering from Cornell. Prof. Wheeler's research interests lie in the application of electrical engineering methodologies, signal processing and microfabrication, to the study of the nervous system, including the microlithographic control of the patterns of growth of neurons in vitro so as to permit stimulation and recording with microelectrode arrays. Hopefully this work will lead to better understanding of the behavior of small populations of neurons and lead to better insights into the functioning of the brain.

Grand Challenge in Neural Engineering: Can We Forward Engineer a Living Brain?

Abstract - One of the Grand Challenges identified by the National Science Foundation is the Reverse Engineering of the Brain – e.g. taking it apart of learning it how it works so that the principles can be used in many fields of science and engineering. Here I propose that a more exacting challenge is Forward Engineering of the Brain – the design and construction of ever more complex living neural circuits that emulate brain function. While certainly a wild idea, is closer to reality than is reasonable to expect, thanks to applications of both engineering and applied biology. The metaphor works both ways: applications of more traditional engineering technologies – signal processing, electronics, microlithography, materials science – make possible the controlled growth, recording, and stimulation of nerve cells. In turn the goal is to design, construct, test, and utilize – in short to engineer – a working biological construct. In this lecture examples illustrate the component technologies that have been utilized in this pursuit, as well as examples illustrating how the approaching the problem as an engineer leads to the asking new questions.

Alex C. Kot
Nanyang Technological University

Dr Kot has been with the Nanyang Technological University, Singapore since 1991. He headed the Division of Information Engineering at the School of Electrical and Electronic Engineering for eight years until 2005. He started serving as Vice-Dean (Research) for the School of EEE in 2005 and became Associate Dean for the College of Engineering in 2008. He is currently a Professor at the School of EEE and Associate Dean for the College of Engineering. He has published extensively with over 200 technical papers and 3 patents in the areas of signal processing for communication, biometrics recognition, data-hiding, authentication and media forensics.

Dr. Kot served as Associate Editor for the IEEE Trans. on Signal Processing, IEEE Trans. on Multimedia, IEEE Trans. on Circuits and Systems for Video Technology; and IEEE Trans. on Circuits and Systems Part II as well as Part I. He is currently Associate Editor for the IEEE Trans. on Information, Forensics and Security, IEEE Trans. on Image Processing and IEEE Signal Processing Letter. He is also Editor for the EURASIP Journal of Advanced Signal Processing, the IEEE Signal Processing Magazine and the IEEE Journal of the Special Topics in Signal Processing. He has served as the General Co-Chairs for the 2004 IEEE International Conference on Image Processing (ICIP) and Chair of the worldwide SPS Chapter Chairs and the Distinguished Lecturer program. He serves as IEEE Fellow Evaluation Committee. He received the Best Teacher of the Year Award and is a co-author for several Best Paper Awards including ICPR, WIFS and IWDW. He was the IEEE Distinguished Lecturer in 2005 and 2006 and is a Fellow of IEEE and a Fellow of Academy of Engineering, Singapore and Vice President-elect for IEEE Signal Processing Society.

Is Your Biometrics Data Safe?

Abstract - Nowadays, biometrics is widely used in authentication systems. In general, biometrics needs to be stored in a database for subsequent authentication. However, templates stored in the database are at the risk of being stolen or modified. Once the template is stolen, it is difficult to be replaced like passwords and the private user information associated with the stolen template would also be exposed. Thus, biometrics templates should be stored in the database such that both the security of the template and the privacy of the user are not compromised under various attacks.

This talk will cover some existing techniques in dealing with biometrics data protection. A new scheme is proposed to reconstruct a full fingerprint image from the minutiae points to show the vulnerability. However, such reconstruction technique is useful to create a new fingerprint based on two sets of minutiae from two different fingers. A novel data hiding scheme is also proposed for the thinned fingerprint template.

Xiaoou Tang
Chinese University of Hong Kong

Xiaoou Tang (S'93-M'96-SM'02-F'09) received the B.S. degree from the University of Science and Technology of China, Hefei, in 1990, and the M.S. degree from the University of Rochester, Rochester, NY, in 1991. He received the Ph.D. degree from the Massachusetts Institute of Technology, Cambridge, in 1996.

He is a Professor in the Department of Information Engineering and Associate Dean (Research) of the Faculty of Engineering of the Chinese University of Hong Kong. He worked as the group manager of the Visual Computing Group at the Microsoft Research Asia from 2005 to 2008. His research interests include computer vision, pattern recognition, and video processing.

Dr. Tang received the Best Paper Award at the IEEE Conference on Computer Vision and Pattern Recognition (CVPR) 2009. He is a program chair of the IEEE International Conference on Computer Vision (ICCV) 2009 and served as Associate Editor of IEEE Transactions on Pattern Analysis and Machine Intelligence (PAMI) and International Journal of Computer Vision (IJCV). He is a Fellow of IEEE.

In Pursuit of a Beautiful Search

Abstract - With the explosive growth of the Internet, the web-scale image search has become both challenging and interesting. On one hand, it is challenging to find what we are looking for; on the other hand, it is always interesting to explore and discover beautiful photos beyond expectation. In this talk, we will investigate these two sides of the image search experience. We start with our face image search work by discussing our recent study on the learning based encoding for face recognition and identity association based face recognition. We then move on to the general image search on the Internet. Using the one-click image search re-ranking framework and the visual semantic signatures, we try to improve the search results by capturing the users' search intention with minimum user interaction. The work has been adopted by Microsoft Bing image search engine. To further improve the image search experience, we explore a new research area, the content based photo quality assessment, i.e. finding beautiful photos. Previously, the photo quality assessment only deals with low level image degradation caused by noise or artifacts. We propose to evaluate photo quality from an aesthetic point of view and try to model the high level factors that make a photo look beautiful, so that we can distinguish the professional photos from the amateur ones. This pioneer work has been shown to be useful both for filtering image search results and for helping people to take better pictures.

Metin Akay, Symposium Organizer
University of Houston

Metin Akay received his B.S. and M.S. in Electrical Engineering from the Bogazici University, Istanbul, Turkey in 1981 and 1984, respectively and a Ph.D. degree from Rutgers University in 1990. He is currently the founding chair of the new Biomedical Engineering Department and the John S. Dunn professor of biomedical engineering at the University of Houston.

He has played a key role in promoting biomedical education in the world by writing and editing several books, editing several special issues of prestigious journals, including the Proc of IEEE, and giving several keynote and plenary talks at international conferences, symposiums and workshops regarding emerging technologies in biomedical and healthcare engineering.

He is the founding editor-in-chief of the Biomedical Engineering Book Series published by the Wiley and IEEE Press and the Wiley Encyclopedia of Biomedical Engineering. He is also the editor of the Neural Engineering Handbook published by Wiley/IEEE Press and the first steering committee chair of the IEEE Trans on Computational Biology and Bioinformatics. He established the Annual International Summer School on Biocomplexity from Gene to System sponsored by the NSF and the IEEE EMBS and is the founding chair of the IEEE EMBS Special Topic Conference on Neural Engineering. He is also the founder director of the US-Turkey Advanced Institute on Healthcare, sponsored by the NSF and endorsed by the NAE.

He is also the chair of the IEEE EMBS Neuroengineering Technical Committee. He was the program chair of the International IEEE EMBS 2001 and the Co-Chairs of the International IEEE EMBS 2006. He currently serves on the advisory board of several international journals including the IEEE T-BME, IEEE T-ITIB, Smart Engineering Systems etc. and furthermore serves on several NIH and NSF review panels

Dr. Akay is a recipient of the IEEE EMBS Early Career and IEEE EMBS Service awards, the first Information Technology Applications in Biomedicine (ITAB) Leadership award as well an IEEE Third Millenium Medal and is a fellow of IEEE, the Institute of Physics (IOP), the American Institute of Medical Biological Engineering (AIMBE) and the American Association for the Advancement of Science (AAAS). His Neural Engineering and Informatics Lab is interested in developing an intelligent wearable system for monitoring motor functions in Post-Stroke Hemiplegic Patients and detecting coronary artery disease. In addition, his lab is currently investigating the effect of nicotine on the dynamics of ventral tegmental area (VTA) dopamine neural networks.

Investigating the Effects of Prenatal Nicotine Exposure on the Mesocorticolimbic System

Die Zhang, Andrei Dragomir, Yasemin M Akay and Metin Akay

Abstract - Dopaminergic (DA) neurons in the ventral tegmental area (VTA) are widely implicated in the drug and natural reward circuitry of the brain. They are shown to be play an important role in drug addiction, motivation, cognition and several psychiatric disorders. These neurons project to numerous areas of the brain, from the prefrontal cortex (PFC), Nucleus Accumbens (NAc) to the caudal brainstem. Their firing patterns were shown to be important modulators of dopamine release, being thus essential for reward processing. Previous studies attempted at characterizing the neural activity of DA neurons using a variety of methods including conventional firing irregularity measures, firing rate estimation methods and spectral analysis.

Previous studies showed a clear evidence that PIF DA neurons project to habenula which is also interconnected with the frontal cortex and NAc (OT Phillipson & CJ Pycock). Furthermore, recent publications highlight differences within the sub-regions of VTA (among PIF and PBP&PN, respectively) in what concerns the projections to the PFC and related to the glutamatergic pathway (T. Yamaguchi et al & N. Gorelova et al.).

In order to characterize the effects of prenatal nicotine exposure on the mesocorticolimbic system of the rat offsprings, we recorded extracellular single unit firing activity of VTA DA neurons Electrode were placed into the VTA through a small burr hole in the rat skull (3.0 mm anterior to the lambda and 0.5–0.9 mm lateral to the midline). Local field potentials and extracellular single unit activities were recorded from 27 sites across VTA of 11 rats aged 42-65 days. The extracellular VTA neural activities were analyzed using Approximate Entropy (ApEn) method. Approximate entropy values were then grouped according to each anatomic location including the parabrachial pigmented nucleus (PBP), parainterfascicular nucleus (PIF) and paranigral nucleus (PN);

Our results have showed that the local field potentials corresponding to the neurons located in para-interfascicular nucleus (PIF) region of the VTA have approximate entropy values significantly higher ($p = 2x10\text{-}4$) in the maternal nicotine cases when compared to the saline. Therefore, we conclude that the dopamine neurons located in the PIF sub-region of the VAT are highly likely involved with the nicotine addication.

Organizing Committee

BMEI 2012

General Chair

Qianbin Chen, *Chongqing University of Posts and Telecommunications, China*

Program Committee Co-Chairs

Jun (Luke) Huan*, University of Kansas, USA*
Yong Xu*, Wayne State University, USA*

Steering Committee Chair

Lipo Wang, *Nanyang Technological University, Singapore*

Organizing Committee Chair

Fang Cheng, *Chongqing University of Posts and Telecommunications, China*

Proceedings Chair

Tianqi Zhang, *Chongqing University of Posts and Telecommunications, China*

Publicity Chair

Qiong Huang, *Chongqing University of Posts and Telecommunications, China*

Sponsorship Chair

Ting Zhang, *Chongqing University of Posts and Telecommunications, China*