IEEE EMBS Distinguished Lecture (Oct. 14, 2010)

at

Dept. of Biomedical Engineering College of Electronics and Information Kyung Hee University

Time	Room	Topic	Speaker
15:30-16:00	211-1	Registration (Free)	
16:00-16:30	211-1	Advances (innovations) in neural engineering and informatics	Metin Akay
16:30-17:00	211-1	Use of a wearable motion sensor to improve the quality of life	Toshiyo Tamura
17:00-17:30	211-1	Investigating the Influence of Prefrontal cortex deletion on the dopaminergic neural firing complexity in nicotine-treated ventral tegmental area	Yasemin Akay
17:30-19:00	Terrace	Reception	

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Dr. 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-chair 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 Service awards 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.

Advances (innovations) in neural engineering and informatics

Neural Engineering is a new discipline which unites engineering, computer science, physics, chemistry, and mathematics with cellular, molecular, cognitive and behavioral neurosciences, to understand the organizational principles and underlying mechanisms of the biology of neural systems, and to study the behavior dynamics and complexities of neural systems in nature. Therefore, it deals with many aspects of basic and clinical problems associated with neural dysfunction including the representation of sensory and motor information, the electrical stimulation of the neuromuscular system to control the muscle activation and movement, the analysis and visualization of complex neural systems at multi-scale from the single-cell and to the system levels to understand the underlying mechanisms, the development of novel electronic and photonic devices and techniques for experimental probing, the neural simulation studies, and the design and development of human-machine interface systems and artificial vision sensors and neural prosthesis to restore and enhance the impaired sensory and motor systems and functions from gene to system.

Furthermore, the neuroscience has become more quantitative and information-driven science since emerging implantable and wearable sensors from macro to nano and computational tools facilitate collection and analysis of vast amounts of neural data. Complexity analysis of neural systems provides physiological knowledge for the organization, management and mining of neural data by using advanced computational tools since the neurological data are inherently complex and non-uniform and collected at multiple temporal and spatial scales.

To highlight this emerging discipline, we devote this talk to the recent advances in neural engineering and informatics.

Dr. Toshiyo Tamura received his BS and MS degrees from Keio University, Japan, in 1971 and 73, respectively and Ph.D. from Tokyo Medical and Dental University in 1980. He is currently a Professor, Department of Medical System Engineering, Graduate School of Engineering, Chiba University, Japan. He also holds several adjunct positions in universities in Japan.

His research interests include biomedical instrumentation, biosignal processing, telemedicine telecare and home care technology. His research has resulted in over 100 reviewed articles.

He has served as a chair of IEEE/EMBS Tokyo Chapter in 1996-2000, and the Asian Pacific representative for the EMBS from 2000 to 2004. He is currently Presidents of Japanese society of Medical Electronics and Biological Engineering, and Japanese Society of Life Support Technology.

Use of a wearable motion sensor to improve the quality of life

In rehabilitation field, wearable motion sensors become popular and the quantitative analysis was attempted. However, the data obtained from motion sensor were relatively difficult to interpret the gait performance for the subjects. Although the RMS of acceleration and gyro signals showed the reproducibility of step and stride, the effective criterion could not obtain. In this study, we have attempted the evaluation of acceleration and gyro signals with comparison of Activities of Daily Living (ADL) score The experiments were performed to 10 m walking and step exercise by 9 health younger subjects and 10 elderly people who required support in the daily life. The result indicated that the ADL score is weakly correlated to the RMS of acceleration signal. However, the relationship between walking speed and RMS was highly correlated. Furthermore, the repeatability of step exercise indicated the difference of walking style. In conclusion, the obtained acceleration and gyro signals may help us the evaluation of daily activities and rehabilitation training quantitatively.

Dr. Yasemin M Akay received her B.S. in Pharmaceutical Sciences from the Hacettepe University, Ankara, Turkey in 1980 and M.S. and Ph.D in Biomedical Engineering from the Rutgers University, Piscataway, NJ, USA in 1991 and 1998, respectively. She was a postdoctoral fellow at the Physiology and Pharmacology Departments, Dartmouth Medical School and at the Department of Physiology and Biophysics, Boston University, School of Medicine. She was a Research Assistant Professor at the Harrington Department of Bioengineering and is currently a Research Assistant Professor at the Department of Electrical and Computer Engineering, Cullen College of Engineering, University of Houston. Her current research interests include Molecular Neuroengineering, Neural Growth and Neurodegeneration.

Investigating the Influence of Prefrontal cortex deletion on the dopaminergic neural firing complexity in nicotine-treated ventral tegmental area

Ting Y. Chen, Andrei Dragomir, Die Zhang, ***Yasemin Akay*** and Metin Akay

Nicotine, an addictive substance in cigarette, triggers glutamatergic synaptic plasticity on ventral tegmental area (VTA) dopamine (DA) neurons. The functional coupling between prefrontal cortex (PFC) and VTA has been demonstrated, but little is known how PFC mediates nicotinic modulation in VTA DA neurons. In this study, we tested the hypothesis that systemic exposure to nicotine significantly increases the VTA DA neuron's complexity of firing. The complexity of the neural firing of VTA DA neurons was significantly increased in PFC intact subjects, as determined using the advanced nonlinear dynamic method based on the Lempel-Ziv estimator. To further understand the functional coupling between PFC and VTA, we used LZ complexity method to estimate the complexity of firing of PFC transected subjects. Interestingly, without the input from PFC, the change in complexity estimated from VTA for PFC transected subjects is not significant. The results suggest PFC plays an important role in mediating VTA activity and that the LZ complexity method is a useful tool for the characterization of the dynamical changes in VTA DA neurons firing activities.