Neuroengineering Seminar

Atomic Force Microscopy and Molecular Nanotechnology for Systems Neuroscience and Neuroengineering

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4:00-5:00pm
Fung Auditorium, Powell-Focht Bioengineering Building
University of California San Diego

Bio-nanotechnology is promising to measure, monitor and manipulate fundamental biological processes at spatial and temporal multiscales. Their relevance spans from single molecule to system level understanding of the normal physiology and pathological human diseases. Atomic force microscopy (AFM) and AFM-based nanotechnological tools allow visualization and manipulation of living biological systems. Its ability to study multi-scale living systems has the potential to unravel structures and functions currently beyond the scope of existing technological tools. For example, AFM has provided three dimensional molecular scale images of polymorphic structures adopted by amyloid peptides, believed to be at the core of Alzheimer's disease (AD). The amyloid peptides make toxic ion channels that underlie the early events in the pathology of AD, as well as in other neurodegenerative and protein-misfolding diseases. The information then will enable us to screen library of small molecules in drug discovery process. The versatility of AFM application lies in its ability to be integrated with an array of complementary tools and techniques. For, example, AFMs integrated with nanopore devices and electrical recording and imaging tools will give us combined functional and structural information about ion channels, receptors, and synaptic connections that govern almost all neural activity. In the areas of drug delivery, nanotechnologies are being utilized to study and understand physiological barriers like blood brain barrier for effective drug delivery. Development of nanosensors to monitor functions of brain will provide information about the onset of disease as well as for monitoring therapeutic efficacy. Functionalized microcantilever is an excellent sensor for detecting inter-molecular interactions at single molecular level. By engineering an array of soft cantilevers with ultra-low spring constant, bending of the cantilever in response to molecular interactions between molecules in a biofluid and its complement (e.g., antibodies, ligands) is detected by a quantitative piezoelectric readout, optical detectors as well as fluorescence microscopy. This would allow identifying multiple biomarkers in HTS mode as well as for detecting molecular events and constituents of any system level understanding.

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