Seminar Talk

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Friday, October 30, 2015
3:00 p.m. KH 224

Title: Nanoscale Bioelectrical Engineering ‹ Measurements and Models

Abstract:
We are immersed in electric fields. Every sensation we feel, every motion we make, every thought we generate depends on a coordinated network of electrical signals. Electricity can kill us, it can restore our heartbeat, it can give us control over paralyzed limbs. Yet we know surprisingly little about the details of the interactions between electric fields and living cells. Most of what we do know is centered on the cell membrane, the primary transducer of the energy of externally applied electric fields. Of great interest are the effects of electric pulses that are intense enough to affect membranes, but brief enough that they do not cause permanent damage. This is the regime of electropermeabilization (electroporation), where we use pulsed electric fields to modify the barrier function of the membrane to allow normally impermeant pharmacological agents or genetic material to gain access to the cell interior. Applications of electroporation technology include cancer therapy, genetic engineering, and bio-industrial processing. Our investigations of electropermeabilization on the nanoscale, with the tools of molecular modeling and quantitative fluorescence microscopy, reveals an amazing biomolecular complexity, even within a few nanometers, for a few nanoseconds.

Bio:
P. Thomas Vernier is Research Professor at the Frank Reidy Research Center for Bioelectrics at Old Dominion University. His research and industrial experience includes ultraviolet microscopy analysis of S-adenosylmethionine metabolism in a psychrophilic strain of the yeast Rhodotorula glutinis, molecular biology of the temperature-sensitive host restriction of bacterial viruses in Pseudomonas aeruginosa, low-level environmental gas monitoring, wide-band instrumentation data recording, physical and electrical characterization and modeling of semiconductor and microelectromechanical devices, and the integration of cellular and biomolecular sensors, carbon nanotubes, and quantum dots with commercial integrated electronic circuit fabrication processes. He currently concentrates on the effects of electric fields on biological systems, with applications in cancer therapeutics, combining experimental observations with molecular dynamics simulations. His focus is on understanding the biophysical mechanisms that govern electric field-driven, nondestructive perturbations of biological membranes. Vernier received his Ph.D. in Electrical Engineering from the University of Southern California (USC) in 2004.