Seminar Talk

Nicola Lai, Ph.D.
Associate Professor
Electrical & Computer Engineering
Biomedical Engineering Institute
Old Dominion University

Friday, November 06, 2015
3:00 p.m. KH 224

Title: A multi-scale approach to study alteration of energy metabolism

Abstract:
Metabolic diseases are characterized by a disruption of normal metabolism to provide energy at the cellular level. This disruption is due to alterations of the biochemical and biophysical processes leading to physiological dysfunction at cellular, tissue-organ and whole body levels. These alterations are studied with in vivo and in vitro experiments that examine biological responses to physiological stimuli. In response to a stimulus as exercise, oxygen and substrates utilization are measured to study the regulatory mechanisms of energy metabolism. While in vivo experiments provide information on the central and peripheral factors affecting energy metabolism, in vitro experiments provide information on mitochondria bioenergetic. Although mitochondrial studies are essential to investigate the regulation of bioenergetic processes in healthy and disease states, they are not connected to in vivo models of blood-perfused tissue or intact vertebrates. Such a connection is possible using mechanistic mathematical modeling. To quantify metabolic functions, mathematical models are developed to combine biochemical, biophysical and physiological aspects with in vivo and in vitro data. This multi-scale systems approach involves modeling and analysis at cellular, organ and whole organism scales. The multi-scale models quantify fuel utilization and factors limiting oxidative phosphorylation in tissue-organs and whole-body responses to different conditions (e.g. exercise). The computational model validation requires experimental approaches that integrate the characterization of structural and functional properties of the cytosol, whole mitochondrion and of its components with that of tissue-organ responses to stimuli. A systems biology approach is proposed to study skeletal muscle energy metabolism in type 2 diabetes mellitus.

Bio:
Dr. Nicola Lai received his Ph.D. degree in Chemical Engineering from the University of Pisa, Italy in 2002. He was a researcher at the Center for Advanced Studies, Research and Development in Sardinia (CRS4) from 2000 to 2005. He did his postdoctoral studies in the Department of Biomedical Engineering at Case Western Reserve University (CWRU), Cleveland, Ohio where he became Research Assistant Professor in 2009. He was also adjunct professor in the Department of Pediatrics of the School of Medicine at CWRU. In July 2015, he joined ODU's

ECE department as an Associate Professor and core faculty of the Biomedical Engineering Institute. His research interests include mass transport in cells, tissues, and organs; systems integrated physiology; mathematical modeling and simulation of physiological systems. His current research emphasis is on oxygen transport and metabolism and mitochondria bioenergetics in human and animal models.