NU Mechanical and Industrial Engineering Colloquium Series – Spring 08

THURSDAY Jan 17, Shillman 415

SEMINAR TITLE

"Mechanobiology: A new vision of mechanics and materials"

SEMINAR SPEAKER

Dr. Srboljub Mijailovich

Senior Research Scientist

Harvard School of Public Health

PROGRAM

2:50 - 3:00 p.m. Pre-seminar/Intro
3:00 - 3:50 p.m. Lecture (typical)
3:50 - 4:00 p.m. Q&A and Discussion

ABSTRACT

Mechanical forces play an essential role in integrated organ physiology spanning from molecular interactions to vital organ functions such as breathing or blood circulation. Quantitative understanding of mechanical organ dysfunction in disease is based on comprehensive knowledge of dynamic mechanical characteristics of tissues. The classical approach based on dynamic balance between external forces and material resistance to deformation is also applicable to biological systems, but obtaining tissue deformation based on the object geometry, mechanical material characteristic, mechanical load and other boundary conditions is not straight forward. The key problem is to design an experiment to obtain constitutive law of biological materials. The material constants of these materials can not be measured directly because the stress-strain relationship depends on history of deformation and biochemically regulated active force generation and stiffness. We resolved this problem by designing a set of experiments ranging form biochemical reactions, mechano-chemical transduction and regulation, imaging of underlying filamentous structures and dynamic mechanical measurements. The biochemical and structural experiments are integrated in a theoretical model that can predict mechanical measurements under various dynamic loads and levels of biochemical activation. This model carries over complete history of deformation and biochemically regulated state. Once validated this model can predict current mechanical characteristics in any point of a three dimensional object subjected to dynamic loads and can be used in simulation of the organ function or dysfunction. As an example we have developed a model of airway narrowing essential for comprehensive understanding of Asthma.

BIOGRAPHIC PROFILE

Dr. Mijailovich received his Batchelor's and Master's degrees from the University of Belgrade in 1975 and 1982 respectively. He came to the United States and completed his Ph.D. at MIT in 1991 on the topic of elasticity and energy dissipation in the lung. He has been at the Harvard University School of Public Health in various capacities since 1991 and currently holds the title of senior research scientist. His current research focuses on the development of quantitative approaches to study biological systems at multiple levels of organization (i.e. multiscale modeling). In particular he is interested in developing a theoretical framework that will advance our understanding of how cellular and subcellular phenomena integrate to impact structure-function and dynamic relations of whole physiological systems, based on the kinetics of underlying molecular processes. His laboratory was established in the fall of 2003 and focuses on the interplay between mechanical forces, cell biology, and integrated organ physiology. He has published widely in the field of biomechanics and holds an NIH R01 on the quantitative engineering analysis of muscle mechanics and metabolism

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