

**Engineering the Human Heart Disease  
using Stochastic Modeling**

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**Abstract**

Heart disease is the leading cause of death in the United States. Many of these diseases are triggered by genetic mutations. For instance, sarcomeric missense mutations affect striated muscle contractility and can lead to various types of inherited cardiac diseases such as hypertrophic and dilated cardiomyopathies. The majority of these mutations have found to be distributed on residues located at the interfaces of many proteins of the sarcomere that regulates cardiac contraction. These mutations and post-translational modifications influence not only contraction dynamics, but affect myofilament calcium sensitivity and alter cooperative interactions between the sarcomere regulatory proteins. Although, several Monte Carlo type myofilament models attempt to predict the functional effects of point mutations on sarcomere contractility. The exact molecular-to-filament mechanism by which these alterations provide the trigger for disease progression and remodeling is still remaining poorly understood.

In this talk, I will present a novel stochastic multiscale (molecular-to-filament) myofilament model that can describe the activation process of the thin filament during sarcomere contraction. The model is based on the Brownian flashing ratchet theory for the molecular scale and is using Langevin dynamics principle for the filament scale. This model is then used to predict the phenotype remodeling of cardiac function during heart failure, which make major strides toward engineering the human heart disease.

**Biography**

Yasser Aboelkassem is currently an Assistant Project Scientist in the Department of Bioengineering at the University of California, San Diego. He completed his BSc in Aerospace Engineering, Cairo University, Egypt. He then obtained a MS degree in Computational Mechanics from Concordia Universities, Montreal, Canada. He then received his MS in Applied Mathematics and his PhD in Engineering Science, both from Virginia Tech. He was a Postdoctoral Associate in the Department of Biomedical Engineering and Medicine at the Johns Hopkins University, and prior to that, He was a Postdoctoral Fellow in The Department of Biomedical Engineering at Yale University. He obtained a mini-MBA degree from Rady School of Management at University of California, San Diego. Dr. Aboelkassem's research focuses on both biomechanics and hemodynamics of the human cardiovascular system, as well as on developing computational medicine tools to better understand the cardiac disease.

***This seminar counts towards the ME 600 seminar requirement for Mechanical Engineering graduate students.***

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