SEMINAR SERIES: DEPARTMENT OF BIOENGINEERING & DEPARTMENT OF PHYSICS

From Structure to Function: Cardiac and Immune Cells

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Date:
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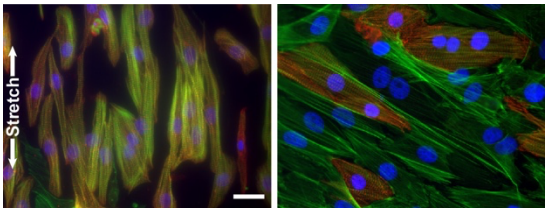
Time:
10:30 AM – 11:50 AM

Location:
GRAN 135

About The Speaker:

Anna Grosberg graduated from University of Minnesota with a Bachelors degrees in Chemical Engineering and Biomedical Engineering. She received her PhD from California Institute of Technology under the guidance of Professor Mory Gharib, where she created a computational model of the myocardium mechanics. She was then a postdoctoral fellow at Harvard University in Professor Kit Parker's Disease Biophysics Group, where she worked on both computational modeling of cellular self-assembly and experimental tissue engineering device design. She started her faculty position in the Department of Biomedical Engineering and the UCI Edwards Lifesciences Foundation Cardiovascular Innovation and Research Center (CIRC) in 2012, and her group has worked extensively in utilizing image analysis to quantify tissue structure and tissue engineering to quantify tissue function. The Grosberg lab has projects ranging from understanding the functional effects of heart disease specific gene-mutations to investigating the self-assembly mechanisms of primary cardiomyocytes.



Abstract:

The heart is a fascinatingly efficient pump with intricate design criteria involving multiple cell types like cardiomyocytes, fibroblasts, and macrophages. While many aspects of heart function remain a mystery, investigations through the prism of physics and engineering can provide invaluable insights – in this talk we will explore a few examples. First, we consider the problem of automatically characterizing cardiac tissue architecture over multiple length-scales. Through, the use of existing and creation of new order parameters and metrics, multiple discoveries were made such as the comparative quality of unorganized tissues and importance of nuclear defects. Second, the self-assembly relationship between cardiomyocytes and fibroblasts was explored in the presence of cyclic strain. By utilizing a novel structure analysis technique, we were able to discover the relationship between relative numbers of fibroblasts and cardiomyocytes and the resultant organization of confluent tissues providing insight into pathological remodeling in fibrosis. Third, a phase model was used to simulate the behavior of motile cells, such as fibroblasts or macrophages, on surfaces with a variety of properties. Through this model, a hypothesis was identified that the motile properties and the shape of the cell greatly depends on the Gaussian curvature of the underlying substrate, which is an important aspect to consider as tissue engineering moves toward bio-printed substrates. Finally, we will consider an example of how tissue engineering tools combined with computation image analysis were used to elucidate the influence of macrophages on cardiac tissues engineered in a dish. Collectively, these examples illustrate the strength of the engineering and physics approaches when applied to cardiac physiology and pathology.

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