Rice University
George R. Brown School of Engineering
Department of Chemical and
Biomolecular Engineering

Presents

Dr. Bomyi Lim

Postdoctoral Associate
Lewis-Sigler Institute for Integrative Genomics
Princeton University

Tuesday, January 24, 2017 - 2:30 PM
Keck Hall 102

Design Principles and Dynamic Control of an Animal Embryo

Transcriptional regulation is a key process that determines when and where a gene needs to be turned on and off to mediate cellular processes. Transcription occurs through highly intertwined genetic circuits, where the systemized DNA-DNA and DNA-protein interactions result in the activation of a target gene. To better understand the principles of dynamic gene control, I employed a combination of live-imaging methods and quantitative analysis to measure gene activity in real time in animal embryos. I will show that different developmental enhancers (regulatory switches) positioned downstream of synthetic reporter genes produce transcriptional bursts with similar amplitudes and duration, but generate different bursting frequencies. By demonstrating that strong enhancers produce more bursts than weak enhancers, and the level of gene expression is correlated with the number of bursts, I propose that the enhancer-mediated regulation of bursting frequency is a key parameter of gene control in development. I will also show that linked reporter genes exhibit coordinated bursting profiles when regulated by a shared enhancer, suggesting the importance of chromosome topology in gene control. Lastly, I will present that transcriptional dynamics of gene expression foreshadow the subsequent developmental dynamics. My study provides clear evidence that transcription activity is indeed stochastic in nature, and enhancer has an ability to modulate transcriptional dynamics. The insights obtained from this study will be relevant to all other gene expression phenomena underlying metabolism, stem cell differentiation, disease, and other aspects of human physiology.

About the Speaker

Dr. Bomyi Lim received a B.S. in Chemical and Biomolecular Engineering from the University of Pennsylvania in 2010 and a Ph.D. in Chemical and Biological Engineering from Princeton University in 2015. Working with Dr. Stanislav Shvartsman on the emerging field of quantitative biology during her Ph.D., she applied her engineering background to quantitatively characterize the regulation of highly conserved ERK enzyme kinetics in vivo. She is currently working with Dr. Michael Levine at the Lewis-Sigler Institute for Integrative Genomics in Princeton University as a post-doctoral associate. Her primary focus of research is on understanding the spatio-temporal regulation of transcription activity. Using the combination of live imaging and quantitative analysis, she has provided comprehensive understanding of the role of dynamic enhancer-promoter interactions in transcriptional regulation. She is interested in further elucidating design principles that provide tight control of gene expression kinetics and subsequent developmental dynamics.