SCIENCE AT THE EDGE

2016 SEMINAR SERIES

Quantitative Biology Graduate Program | Gene Expression in Development and Disease

Qing Nie

Department of Mathematics
Department of Biomedical Engineering
University of California, Irvine

"Stem Cells: Interplay Between Complex Data and Models"

Stem cells are a critical building block of life. *Embryonic stem cells* can differentiate into cells forming ectoderm, endoderm and mesoderm during development, and *adult stem cells* can maintain the normal turnover of regenerative tissues (e.g. blood, skin, intestinal crypts). Recently, there has been an explosion of data on stem cells at various biological scales (e.g. gene expression and epigenetic measurements, lineage tracing, and molecules for intercellular communications). While data collected through different cell lines and animal models provide tremendous details on individual elements under various conditions, many gaps of knowledge and understanding remain on how stem cells carry out their remarkable functions and complex tasks. Mathematical models connecting interacting elements at different scales enable integration of massive, heterogeneous datasets collected with varying methods. In this talk, I will present several modeling frameworks with different complexity on multistage cell lineages driven by stem cells, which account for diffusive signaling molecules, regulatory networks, individual cells, mechanics, and evolution. Questions of our interest include role of feedbacks, stem cell niche for spatial organization, crosstalk between epigenetic and gene regulations, and cellular plasticity. In particular, I will discuss our recent effort on connecting modeling and complex experimental data to elucidate principles for stem cell dynamics in development and regeneration.

References:

1) L. Zhang, K. Radtke, L. Zheng, T. Schilling, Q. Nie. Noise Drives Sharpening of Gene Experssion Boundaries in Zebrafish Hindbrain. Nature Molecular Systems Biology, Nature Molecular Systems Biology, 8:613, 2012.

2) L. Wang, J. Xin, and Q. Nie. A Critical Quantity for Noise Attenuation in Feedback Systems. PLoS Computational Biology, 6(4): e1000764, 2010.

3) A. Lander, K. Gokoffski, F. Wan, Q. Nie, and A. Calof. Cell Lineages and the Logic of Proliferative Control. PLoS Biology, 7(1):e1000015, 2009.

FRIDAY, APRIL 8, 2016

11:30AM, ROOM 1400 BPS

Refreshments at 11:15

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