Md. Shahriar Karim (from Bangladesh) received his undergraduate degree in Electronics Engineering from Motilal Nehru National Institute of Technology, Allahabad, India in 2005. Shahriar was the recipient of Indian Council for Cultural Relations (ICCR) scholarship for the duration of 2001-2005.

After serving Motorola and Ericsson Bangladesh Ltd. for about 3.5 years, he came to Purdue as a PhD student in the department of Electrical and Computer Engineering in 2009. Later, he started his Master's degree in Agricultural and Biological Engineering under the supervision of David. M Umulis. His current research interests are in the area of mathematical modeling of embryonic development associated with *Drosophila* (commonly known as fruit fly) and *Zebrafish*.

Agricultural & Biological ENGINEERING

Thesis Defense

Speaker: **Md. Shahriar Karim**

Title: **Analysis of Stochastic Receptor Signaling in BMP Pathways**

Major Professor(s): **David M. Umulis**

Date: **Wednesday, November 30, 2011**

Time: **1:30 PM**

Location: **ABE 301**

Abstract:

Morphogens are secreted molecules that specify cell-fate organization in developing tissues. Patterns of gene expression or signaling immediately downstream of many morphogens such as Decapentaplegic (Dpp) are highly reproducible and robust to perturbations. This contrasts starkly with our expectation of a noisy interpretation that would arise out of the experimentally determined low concentration (approximately picomolar) range of Dpp activity, tight receptor binding, and very slow kinetic rates. To investigate mechanisms by which the intrinsic noise can be attenuated in Dpp signaling we focus on a class of secreted proteins known as Surface-associated BMP binding Proteins (SBPs) that bind to Dpp in the extracellular environment and play an active role in regulating Dpp/receptor interactions. We developed a stochastic model of Dpp signaling in *Drosophila melanogaster* and used the model to quantify the extent that stochastic fluctuations would lead to errors in spatial patterning and extended the model to investigate how a secreted binding partner may buffer out signaling noise.

Application:

During organismal development, it is imperative that cells accurately interpret instructional signals to guide their differentiation program. Bone Morphogenetic Proteins (BMPs) are potent growth factors that transduce extracellular information to regulate intracellular gene expression and cell fate decisions. Remarkably, small numbers of BMPs are needed to control cell signaling, which naturally leads to a noisy and unreliable system. Here we find, in mathematical models of BMP signaling that if receptor-ligand interactions are regulated by secreted BMP binding proteins (SBPs), there is a significant increase in signaling fidelity and developmental precision. Utilization of SBPs should also improve stem cell differentiation control.