PHYSICAL MATHEMATICS SEMINAR

QUANTIFYING MORPHOGENESIS AND MORPHOLOGICAL VARIATION

OTGER CAMPAS

Harvard University

ABSTRACT:

Understanding quantitatively the dynamics of complex systems, from physical or biological systems to social systems, has become a central problem in modern science. The recent ability to perform quantitative measurements in biological systems and the large amount of data available have made absolutely necessary the use of mathematical methods to analyze the data and identify patterns in it. In this seminar I will provide two examples where the use of mathematical analysis proves essential to understand the abstract structure behind complex biological phenomena. Specifically, I will discuss the celebrated case of morphological diversity in the beaks of Darwin's finches, a classical example of shape variation across species that inspired Charles Darwin in the developing of his ideas on natural selection, and show that the use of transformation groups reveals the underlying abstract structure of beak shape variations. I will then focus on how to mathematically model the process of morphogenesis in single walled cells, and show that the use of simple effective descriptions based on conservation laws provide an excellent way to approach morphogenesis problems. As an example, I will discuss the interplay between growth and mechanics in shaping a walled cell, in the particularly simple geometry of tip-growing cells. I will derive simple scaling laws for the geometry of the cell and show that a single dimensionless parameter, which characterizes the relative roles of cell wall assembly and expansion, is sufficient to explain the observed variation in shapes of tip-growing cells.

TUESDAY, FEBRUARY 8, 2011
2:30 PM
Building 2, Room 105

Refreshments at 3:30 PM in Building 2, Room 290

Massachusetts Institute of Technology