Distinguished Lecture Series

Public Lecture

The Mathematics of Life: Decisions, Decisions

Or

Solving Differential Equations: How Life Depends on It

Distinguished Professor James P. Keener

University of Utah

Human Sciences Building Room 169
Thursday, March 6, 2014 at 3:30 p.m.
Reception after the Lecture in Mathematics & Statistics Lobby

Abstract:

As we learn more and more about biological processes, the need for mathematical methods to aid us in understanding these complex processes becomes even greater. The use of mathematics to describe biological processes has a long and impressive history with many famous names including Euler, Lotka, Volterra, Malthus, Fisher, Hodgkin, Huxley, and Turing. The common feature of the work of all of these scientists is that they used differential equations and the ideas of calculus to count things, and this way of counting has significant benefits.

A fundamental problem that all living organisms must solve is how to take measurements and make decisions on the basis of those measurements. The classic works of Hodgkin and Huxley and Turing showed us that important biological processes such as signaling in nerves (HH) and morphogenetic pattern formation (Turing) can be understood via the mathematics of diffusion and reaction. However, the mechanism by which measurements and decisions based on those measurements are made is still poorly understood, although there are some underlying principles that are coming to light. What we are learning is that the rate of molecular diffusion contains quantifiable information that can be transduced through biochemical reactions to give control over physical measurements and decisions. Equally important, however, is that these processes can be described and studied using differential equations.

In this talk, I will illustrate the use of mathematical models to examine two fascinating examples: quorum sensing (population measurement) by bacteria and length measurement of flagella by bacteria. In this way, I hope to show how organisms act as analog computers to solve differential equations enabling them to make decisions that enable them to survive.

Brief Biography:

James P. Keener is a Distinguished Professor of Mathematics at the University of Utah. He received his Ph.D. from the California Institute of Technology in Applied Mathematics in 1972. He had held a faculty position at the University of Arizona until he moved to the University of Utah in 1979. He has broad research interests encompassing applied mathematics, nonlinear differential equations, chemical and biological dynamics, cardiology, cellular and systems physiology. His current primary research interests are in mathematical biology with an emphasis on physiology. In addition to teaching and research, Professor Keener served as Editor-in-Chief of the SIAM Journal on Applied Mathematics and continues to serve as editor of several leading research journals. He is the recipient of numerous research grants and various awards including being named a SIAM Fellow in 2012. His most recent book entitled Mathematical Physiology, co-authored with James Sneyd, was awarded best title of the year. In addition to his books, he has written over 150 journal articles, and has directed 20 Ph.D. students and numerous postdocs.

Sponsors:

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