Arthur S. Iberall Distinguished Lecture on Life and the Sciences of Complexity

December 2, 2011 ⌘ University of Connecticut ⌘ 4:00 p.m.

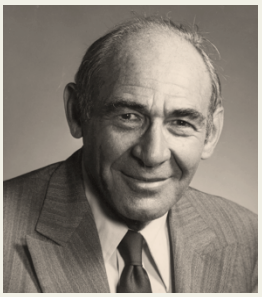
Alvin M. Liberman Room, Bousfield Psychology Building

Biology by Design: From Vibrating Insoles to Synthetic Gene Networks

James J. Collins

Abstract

In this talk, I describe how nonlinear dynamical approaches can be used to study, mimic and improve biological function at multiple scales, ranging from whole-body dynamics to gene networks. I describe, for example, how input noise can be used to enhance human sensory function and motor control. Specifically, touch sensation and balance control in young and older adults, patients with stroke, and patients with diabetic neuropathy can be improved with the application of sub-sensory mechanical noise, for example, via vibrating insoles. I describe how this work has led to the creation of a new class of medical devices to address complications resulting from diabetic neuropathy, restore brain function following stroke, and improve elderly balance. I also describe how techniques from nonlinear dynamics and molecular biology can be used to model, design and construct engineered gene networks, leading to the development of the field of synthetic biology. Finally, the implications of synthetic gene networks for biotechnology, biomedicine and biocomputing are discussed.



ARTHUR S. IBERALL DISTINGUISHED LECTURE SERIES

Dedicated to the exploration of connections between physical processes and their manifestations in nature, life, humankind, mind, and society. The series honors the physicist, Arthur S. Iberall (1918-2002), whose intellectual legacy includes homeokinetics, a method of applying the laws of thermodynamics to all self-organizing systems. His applied research contributed significantly to the development of the first space suit, the high-speed dental drill, stove surface burners, the fancy-stitch sewing machine, and the electric knife.

James J. Collins, Distinguished Professor of Biomedical Engineering and of Medicine, is Co-Director of the Center for BioDynamics at Boston University, and a core founding member of the Wyss Institute for Biologically Inspired Engineering at Harvard University. He is a gifted and committed teacher who has won numerous teaching awards at Boston University. His research group works in synthetic biology and systems biology, with a particular focus on network biology approaches to antibiotic action and bacterial defense mechanisms. His inventions and technologies have been licensed by several biotech and medical device companies. He was identified in *Technology Review's* inaugural list of 100 young innovators who will shape the future of technology, and by *Scientific American* as one of the top 50 outstanding leaders in science and technology. He is a Fellow of the American Physical Society, the American Institute for Medical and Biological Engineering, and was recently elected to the National Academy of Engineering. He is also the recipient of a MacArthur Foundation Award (commonly referred to as the Genius Award) "…for identifying abstract principles that underlie complex biological phenomena and for using these concepts to solve concrete, practical problems." And he was honored as a Medical All-Star by the Boston Red Sox, and threw out the first pitch at a Red Sox game in Fenway Park.