UCLA ENGINEERING Chemical and Biomolecular Engineering



SEMINARS IN CHEMICAL AND BIOMOLECULAR ENGINEERING



Friday, Sept 28th, 2018 | 10:00AMBoelter Hall 3400Presented by:Doraiswami RamkrishnaProfessor

Department of Chemical Engineering Purdue University

"Modeling Transfer of Antibiotics Resistance among Bacterial Species"

Indiscriminate use of antibiotics over the years has led to the development of highly resistant strains of bacterial infection that have become an alarming source of concern as they have the capacity to transfer their drug resistance to other strains. Drug resistance is encoded in a plasmid DNA in the "donor" organisms which is transferred to "recipient" organisms through a process of conjugation initiated by "quorum sensing" signaling molecules.

The pathogen, Enterococcus faecalis, is a leading cause of hospital acquired infections. Through conjugation, plasmid-free recipients receive a plasmid (pCF10) transferred from the donor cells, and subsequently become resistant to the antibiotic. In this process, two signaling molecules, iCF10 and cCF10, regulate the generic circuit for conjugations and affect the response of both recipients and donors; iCF10 and cCF10, produced from donors and recipients respectively, play opposite roles for this plasmid transfer. The presence of iCF10 suppresses conjugation whereas cCF10 will induce and promote plasmid transfer. Whether or not successful conjugation occurs depends on the relative domination of the signaling molecules cCF10 and iCF10.

This seminar will report on our modeling effort as part of a collaborative project between the University of Minnesota and Purdue University towards developing quantitative understanding of the transfer of antibiotics resistance among bacterial species. The mathematical framework uses stochastic modeling of biological signaling with distinction between single cell behavior and its implication to a population of cells in planktonic and biofilm environments. Model simulations are shown to demonstrate how recipient cells convert to donors in varying environments in which the two species coexist with a potential for suggesting strategies for intercepting the transfer of drug resistance.

Doraiswami Ramkrishna, popularly known as Ramki, obtained his Bachelor's degree in Chemical Engineering in 1960 from the Bombay University Department of Chemical Technology, now known as ICT. He received his PhD in 1965 from the University of Minnesota, and after serving for two years on the faculty at Minnesota, returned to India to join the IIT Kanpur as an Assistant Professor. In 1974, he went back to the United States as a Visiting Associate Professor at the University of Wisconsin and as a Visiting Professor the following year at the University of Minnesota before joining the Purdue University faculty in 1976 as a full Professor. In 1994, he was appointed H.C. Peffer Distinguished Professor. Professor Ramkrishna is noted for his research on the application of mathematics to chemical and biochemical reaction engineering, biotechnology, particulate systems, and more recently personalized medicine. He is well known for the book Linear Operator Methods in Chemical Engineering (Prentice-Hall, 1985) coauthored with Neal Amundson, and his book Population Balances. Theory and Application to Particulate Systems in Engineering (Academic Press, 2000).

He is a recipient of several AIChE Awards, the Alpha Chi Sigma (1987), the Richard Wilhelm Award (1998), the Thomas Baron Award (2004). He is a Fellow of professional societies, American Institute of Medical and Biological Engineering (1996), and of the American Institute of Chemical Engineers (2008). From Germany, he won the Senior Humboldt Award (2001) to visit the Max Planck Institute in Magdeburg. He received an Honorary Doctor of Science (2004) from the University of Minnesota. Bombay University honored him with the UDCT Diamond Award (1994), the Platinum Award (2009) and Ruia College with the Jewel of Ruia Award. Professor Ramkrishna has held several Distinguished Professorships and delivered numerous Distinguished Lectures. In (2009) he was elected to the US National Academy of Engineering, and as a foreign member to the Indian National Academy of Engineering in 2011.