TALK

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IEEE AUSTRIA SECTION
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CHAPTER

Topic: **Biological communication networks: A first step in modeling and analysis**

Presenter: Prof. Dr. Urbashi Mitra
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Abstract:

Abstract: We review how biological systems undertake signaling specifically examining, signal transduction and signaling via electrons and molecules. Key processes will be reviewed and important mathematical abstractions provided. With essential building blocks in place, several biological communication systems will be investigated including different modulation methods, associated demodulation strategies and network frameworks. Two illustrative biological networks based on bacterial populations will be examined: electron transfer in bacterial filaments (multi-hopped bacterial networks) and the inducement of quorum sensing in homogeneous populations (multi-terminal bacterial networks). Queues are shown to be a simple, yet powerful method by which such systems can be modeled. Our initial models provide excellent match with experimental data. While the diffusion of chemical signals in the surrounding medium of biological systems has been heavily studied, the role of such processes is not fully understood in certain bacterial interactions. Our queuing models further suggest biologically relevant channel models for information theoretic analysis of larger systems. Our studies are motivated by the fact that microbial communities play a significant role in bioremediation, plant growth promotion, human and animal digestion, disease, elemental cycles, the carbon-cycle and maintaining clean water.

Bio:

Urbashi Mitra received the B.S. and the M.S. degrees from the University of California at Berkeley and her Ph.D. from Princeton University. Prior to her PhD studies, she was a Member of Technical Staff at Bellcore. After a six-year stint at the Ohio State University (OSU), she joined the Department of Electrical Engineering at the University of Southern California (USC), Los Angeles, where she is currently a Dean's Professor of Electrical Engineering. She is the inaugural Editor-in-Chief for the IEEE Transactions on Molecular, Biological and Multi-scale Communications. Dr. Mitra is a Distinguished Lecturer for the IEEE Communications Society for 2015-2016. She is a member of the IEEE Information Theory Society's Board of Governors (2002-2007, 2012-2017) and the IEEE Signal Processing Society's Technical Committee on Signal Processing for Communications and Networks (2012-2016). Dr. Mitra is a Fellow of the IEEE. She is the recipient of: a 2016 United Kingdom Royal Academy of Engineering, Distinguished Visiting
Fellowship, a 2015 Insight Magazine STEM Diversity Award, 2012 Globecom Signal Processing for Communications Symposium Best Paper Award, 2012 US National Academy of Engineering Lillian Gilbreth Lectureship, USC Center for Excellence in Research Fellowship (2010-

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2013), the 2009 DCOSS Applications & Systems Best Paper Award, Texas Instruments Visiting Professor (Fall 2002, Rice University), 2001 Okawa Foundation Award, 2000 OSU College of Engineering Lumley Award for Research, 1997 OSU College of Engineering MacQuigg Award for Teaching, and a 1996 National Science Foundation CAREER Award. She has been an Associate Editor for the following IEEE publications: Transactions on Signal Processing (2012--2015), Transactions on Information Theory (2007-2011), Journal of Oceanic Engineering (2006-2011), and Transactions on Communications (1996-2001). She has co-chaired: (technical program) 2014 IEEE International Symposium on Information Theory in Honolulu, HI, 2014 IEEE Information Theory Workshop in Hobart, Tasmania, IEEE 2012 International Conference on Signal Processing and Communications, Bangalore India, and the IEEE Communication Theory Symposium at ICC 2003 in Anchorage, AK; and was the general co-chair for the first ACM Workshop on Underwater Networks at Mobicom 2006, Los Angeles, CA. She served as co-Director of the Communication Sciences Institute at the University of Southern California from 2004-2007. Her research interests are in: wireless communications, communication and sensor networks, biological communication systems, detection and estimation and the interface of communication, sensing and control.