BIO ENGINEERING SEMINAR

at 4:00 PM on September 1st , 2014
MMCR, Mechanical Engineering

System Theoretic Techniques in Systems and Synthetic Biology

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Abstract: Biology is the science of the century. Life is an information-driven chemical process in which DNA encodes basic programs and creates systems to execute those. Here, the resulting molecular systems and actuators make decisions using molecular sensors. The problem of controlling such complex dynamical systems using limited amount of information has emerged as one of the most important challenges for science and technology. A control theoretic approach is useful in approaching a good enough solution to this problem. Indeed, as George Zames pointed out in 1966, the input-output stability theory aims and works towards facilitating qualitative assessments using only a coarse level system information that may be entirely devoid of any details on the internal structure of the given system. Here, the art is in extracting as much information as possible from the available data so that the conservatism in the characterization and control is minimized.

This talk is broadly divided into two parts: (1) modeling of nonlinear systems using sparse datasets, and (2) a synthesis of nonlinear dynamical systems using biomolecular components. The first presents results on how compressive sensing ideas can be used to obtain nonlinear dynamical models using sparse omics datasets and highlights the efficiency of this approach using the benchmark synthetic data of Cantone *et. al.* (Cell 2009). The second part presents techniques and a software to synthesize nonlinear dynamical systems using chemical reactions and, in particular, using DNA and enzymes.

About the speaker:

Dr. Vishwesh Kulkarni received Ph.D. in Electrical Engineering from the University of Southern California in 2001 and was a postdoctoral researcher at the Massachusetts Institute of Technology, 2001-2003, and at the University of Colorado, Boulder, 2004-2005. He was a faculty at the Department of Electrical Engineering, Indian Institute of Technology Bombay, 2006-2010, and also served as a co-founder and the president of Sentina Systems Inc., Boston, MA, 2005-2010. Along with Prof. Guy-Bart Stan (Imperial College) and Prof. Karthik Raman (IIT Madras), he is a co-editor of the book *System Theoretic Approaches to Systems and Synthetic Biology*, published by Springer Verlag. He is currently a consultant at Strand Life Sciences in Bangalore and will join the University of Warwick as a faculty starting January 2015.