Control of Large-Scale Complex Systems

Dr. Sr-Shin Li
Department of System Engineering
Division of Biology & Biomedical Sciences
Washington University, St. Louis

Abstract
Many applications in control of biological and quantum mechanical systems involve manipulating a large number of structurally similar dynamical systems with the same control signal. This control input is an open-loop since the state feedback is either difficult or impossible to obtain. Typical applications include the design of pulse sequences in Nuclear Magnetic Resonance (NMR) spectroscopy and imaging (MRI) and the development of external current stimuli in neurological treatment such as Parkinson’s disease and epilepsy. These practical control designs motivate a new class of control problems called Ensemble Control. In this talk, I will introduce the notion of ensemble controllability of ensemble control systems. In addition, I will highlight a unified computational method based on pseudospectral approximations for solving optimal control problems arising from the area of ensemble control. Optimal pulses for protein NMR spectroscopy and MRI as well as minimum-power current stimuli for spiking a neural network derived by our newly developed numerical method will be illustrated.