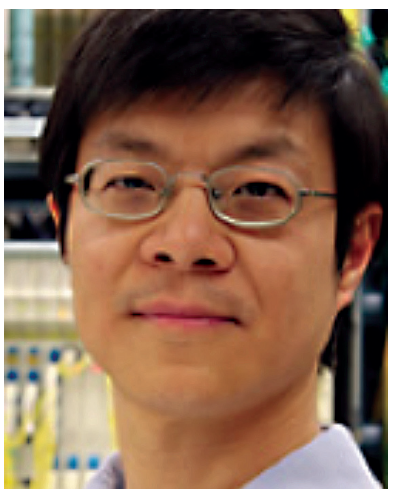
ECE DISTINGUISHED SPEAKER SERIES



Prof. Steven Low

Computing & Mathematical Sciences and
Electrical Engineering Departments
Caltech

Host: Prof. Edmund Yeh
(eyeh@ece.neu.edu)

Optimal Power Flow and Relaxation Methods

Thursday
November 15th, 2012
Room 378 in 140 The Fenway
4:00-5:00 pm
Reception to follow

Sponsored by the Department of Electrical and Computer Engineering

The optimal power flow (OPF) problem seeks to optimize a certain objective function, such as power loss, generation cost and/or user utilities, subject to Kirchhoff's laws, power balance as well as capacity, stability and contingency constraints on the voltages and power flows. It is a nonconex problem and therefore hard to solve. In this talk I will explain two recent approaches to solving OPF through convex relaxations. The first method uses a bus injection model and cast OPF as a nonconvex quadratically constrained quadratic program. This leads to semidefinite relaxation and a simple method to solve for a candidate solution and check if it is globally optimal for the nonconvex problem. We prove that for radial networks, the semidefinite relaxation is always exact provided that the constraints satisfy a simple pattern. The second method uses a branch flow model and leads to a new relaxation method through second-order cone program (SOCP). For radial networks, we prove that the SOCP relaxation is exact, provided there are no upper bounds on loads. For mesh networks, we propose a simple method to convexify the network using phase shifters so that the SOCP relaxation is always exact and OPF for the convexified network can always be solved efficiently for a globally optimal solution. We prove that convexification requires phase shifters only outside a spanning tree of the network graph and their placement depends only on network topology, not on power flows, generation, loads, or operating constraints. Since power networks are sparse, the number of required phase shifters may be relatively small. Finally we prove the equivalence of these two models and their relaxations.

(Joint work with Subhonmesh Bose, Mani Chandy, Masoud Farivar, Caltech, and Javad Lavaei, Columbia)

Steven H. Low is a Professor of the Computing & Mathematical Sciences and Electrical Engineering Departments at Caltech, and an adjunct professor of both the Swinburne University, Australia and the Shanghai Jiao Tong University, China. He was a co-recipient of IEEE best paper awards, the R&D 100 Award, an Okawa Foundation Research Grant, and was on the editorial boards of major networking, control, and communications journals. He is an IEEE Fellow, and received his B.S. from Cornell and PhD from Berkeley, both in EE.

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