

## *Some Optimization Problems in Smart Grids*

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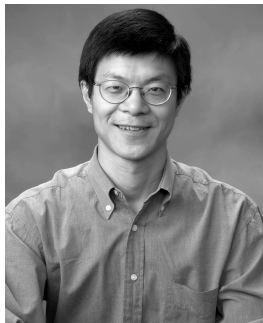
California Institute of Technology (Caltech)

Friday, April 13, 2018, 2:00pm – 2:50pm, Location: BB 3.03.24

### Abstract

Optimal power flow (OPF) is fundamental because it underlies numerous power system operation and planning problems. In this talk, I will give a sample of optimization problems in the management of a large network of distributed energy resources. The nonlinearity of power flow equations leads to the nonconvexity of OPF, one of the main computational challenges in power system applications. We describe a method to deal with nonconvexity through semidefinite relaxation. Semidefinite programs are hard to scale to large OPF problems. We describe a highly scalable distributed solution based on ADMM. These algorithms are offline in that they iterate until the computation has converged before applying the final solution to the grid, and are therefore not suitable for real-time optimization of distributed energy resources at scale. We describe realtime OPF that explicitly exploits the network as a power flow equation solver and characterize its performance in tracking changing network conditions. Finally, in practice, not all network nodes have sensors or can be controlled. We characterize controllability and observability of power flow dynamics in terms of the spectral properties of its Laplacian matrix. This characterization can be used to optimize the placement of sensors and actuators in the grid.

### Biography



Steven Low is a Professor of the Department of Computing & Mathematical Sciences and the Department of Electrical Engineering at Caltech, and holds visiting professorship in Australia and China. Before that, he was with AT&T Bell Laboratories, Murray Hill, NJ, and the University of Melbourne, Australia. He was a co-recipient of IEEE best paper awards and is an IEEE Fellow. His research on communication networks has been accelerating more than 1TB of Internet traffic every second since 2014. He was a member of the Networking and Information Technology Technical Advisory Group for the US President's Council of Advisors on Science and Technology (PCAST) in 2006. He received his B.S. from Cornell and PhD from Berkeley, both in EE.