## Optimal Power Flow: Online Algorithm & Fast Dynamics

ABSTRACT –The optimal power flow (OPF) problem underlies numerous system operation and planning applications. The computational challenge often arises from the need to solve power flow equations explicitly or implicitly.   The grid however implicitly solves power flow equations in real-time at scale for free.   We propose to explicitly exploits the network as a power flow solver to carry out part of our optimization algorithm. This approach naturally adapts to evolving network conditions.   Specifically, we present an algorithm that adapts controllable devices and interacts continuously with the grid which computes a power flow solution given a control action. Collectively these devices and the grid implement a gradient projection algorithm in real time. We characterize optimality and tracking properties of the algorithm.   We apply this idea to a unified frequency controller at a fast timescale that integrates primary frequency regulation, secondary frequency regulation, and congestion management.   We prove sufficient conditions under which the algorithm converges to a global optimum.

Joint work with Lingwen Gan, Changhong Zhao (NREL), Lina Li (Harvard), Janusz Bialek (Skoltech), Ufuk Topcu (UTexas Austin)
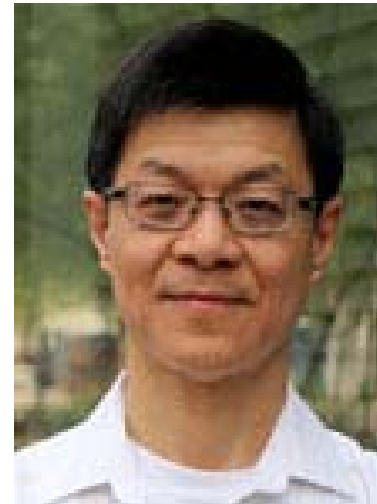
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SPEAKER BIO – Dr. Steven Low is a Professor of the Department of Computing and Mathematical Sciences and the Department of Electrical Engineering at the California Institute of Technology.   Before that, he was with AT&T Bell Laboratories, Murray Hill, NJ, and the University of Melbourne, Australia.   He was a co-recipient of IEEE best paper awards, is Senior Editors of IEEE transactions, and an IEEE Fellow.   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.

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