DEPARTMENT OF ELECTRICAL & COMPUTER ENGINEERING

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ECE/DNSC SEMINAR

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Globally-Optimal Solution Algorithm for Security Constrained AC Optimal Power Flow in Electric Power Grids, Its Variations and Applications

Friday, April 12, 2019, 11:00 am – 12:00 pm

Location: Duques 553

Abstract

Non-convex programming involves optimization problems where either the objective function or constraint set is a non-convex function. These kinds of problems arise in a broad range of applications in engineering systems. Despite the substantial literature on convex and non-convex quadratic programming (general classes of optimization problems), most available optimization techniques are either not scalable or work efficiently only for convex quadratic programming and do not provide adequate results for non-convex quadratic programming. This talk focuses on fundamental research on an integrated approach which the research team expects will lead to powerful solution methods for classes of non-convex programming problems. The new approach will be applicable for non-convex problems arising in many areas, such as power and energy systems, transportation, and communications.

The general difficulty of power and energy optimization problems has a direct impact on power and energy systems management. This is one of the most fundamental concerns that must be dealt with in electrical power system management. The primary objective of this talk is to address the difficulty associated with problem non-convexity by developing high-performance optimization techniques that apply to a broad set of nonlinear energy problems, particularly the Optimal Power Flow (OPF) problem. There is a critical and urgent need for developing smart and robust OPF solvers. The conventional options currently available for DC-OPF are quite limited. I will fundamentally address AC Optimal Power Flow (AC-OPF) with active and reactive quadratically constrained quadratic programming optimization problems of a form that arises in operation and planning applications of the power system. Besides being non-convex, these problems are identified to be NP-hard. The proposed solution method is based on several basic and powerful optimization techniques in convex optimization theory such as DC decomposition approximation techniques, linear and global search procedures, bi-linear and convex relaxation, and alternate direction methods. Also, new schemes and theories must be introduced to establish the convergence of the algorithm and guarantee the global optimality of the solution results. Since the linear programming and convex optimization solvers are robust and fast, and also the power systems community is already familiar with linear and convex programs, the proposed algorithm will be beneficial and user-friendly for the AC-OPF problem. The theoretical investigations to examine the performance of the proposed algorithm and analyze its efficiency on existing testbed systems and synthetic data sets is pursued.

In this talk, I will present my research on 1) A global optimal algorithm for AC-OPF Based on Successive Linear Optimization and DC-Decomposition, 2) Inner approximations of feasible spaces of AC-OPF problems. I will also introduce my research work activities on developing the theoretical aspects of above algorithm and its application in the cyber physical security and emergency management, power system planning, and power distribution network.

Biography

Masoud Barati is Assistant Professor of Electrical and Computer Engineering at the University of Pittsburgh. Prof. Barati received his Ph.D. degree in Electrical Engineering from Illinois Institute of Technology, Chicago, in 2013. Prior to joining Pitt, he was Assistant Professor at University of Houston and Louisiana State University. He is a member of "Microgrid Protection Systems" subcommittee of "Power System Relaying & Control Committee." He is the recipient of IEEE Certificate of Appreciation Award for the establishment of a workshop on Harmonic Power System in IEEE Chicago section with S&C Company. His research interests include developing optimization and mathematical model and algorithms for smart grid, wide area monitoring and power system resiliency and recovery.

Joint seminar with the Department of Decision Sciences in the School of Business. Hosted by Dr. Payman Dehghanian.