Department of Industrial Systems Engineering & Management, NUS, Singapore

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on

Non-convex optimization and statistical properties

Speaker: Xiaoming Huo, Professor, School of Industrial and Systems Engineering; Georgia Institute of Technology

Date: 14 Jun 2018 (Thursday)

Time: 4:00 p.m. to 5:00 p.m.

Venue: E1-06-08, Faculty of Engineering, NUS

Abstract: Non-convex optimization has been introduced into statistics with a range of applications. One application is in the model selection under the sparse regression framework, with the celebrated methods such as the smoothly clipped absolute deviation (SCAD), the minimax concave penalty (MCP), and many more. The newly emerged deep-learning-related techniques often involve non-convex objective functions as well. A non-convex optimization problem is generally NP-hard; therefore there is no guaranteed polynomial-time numerical solution. One can only hope to identify a local optimum. A difference-of-convex (DC) function can be expressed as a difference of two convex functions, though the original function itself may be non-convex. There is a large existing literature on the optimization problems when their objectives and/or constraints involve the DC functions; they are commonly referred to as difference-of-convex algorithms (DCA). Efficient numerical solutions have been proposed. Under the DC framework, directional-stationary (d-stationary) solutions are considered, and they are in general not unique. We show that under some mild conditions, a certain subset of d-stationary solutions in an optimization problem (with a DC objective) has some ideal statistical properties: namely, asymptotic estimation consistency, asymptotic model selection consistency, asymptotic efficiency. The aforementioned properties are the ones that have been proven by many researchers for a range of proposed non-convex penalties in the sparse regression. Our analysis indicates that even with non-convex optimization, some statistical theoretical guarantee can still be established, in some general senses. Our work potentially bridges the communities of optimization and statistics. A joint work with Shanshan Cao.

Biography: Dr. Huo's research interests include statistical theory, statistical computing, and issues related to data analytics. He has made numerous contributions on topics such as sparse representation, wavelets, and statistical problems in detectability. His papers appeared in top journals, and some of them are highly cited. He is a senior member of IEEE since May 2004. He was a Fellow of IPAM in September 2004. He won the Georgia Tech Sigma Xi Young Faculty Award in 2005. His work has led to

an interview by Emerging Research Fronts in June 2006 in the field of Mathematics -- every two months, one paper is selected.

Dr. Huo received the B.S. degree in mathematics from the University of Science and Technology, China, in 1993, and the M.S. degree in electrical engineering and the Ph.D. degree in statistics from Stanford University, Stanford, CA, in 1997 and 1999, respectively. Since August 1999, he has been an Assistant/Associate/Full Professor with the School of Industrial and Systems Engineering, Georgia Institute of Technology, Atlanta. He represented China in the 30th International Mathematical Olympiad (IMO), which was held in Braunschweig, Germany, in 1989, and received a golden prize.

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