



Cornell University

Information, Systems, and Networks seminar

A New Characterization of Compressed Sensing Limits

Rhodes Hall 310: September 15, 2011 @ 12:00PM



ISN Seminar Speaker:
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Abstract

The fact that sparse vectors can be recovered from a small number of linear measurements has important and exciting implications for engineering and statistics. However, despite the vast amount of recent work in the field of compressed sensing, a sharp characterization between what can and cannot be recovered in the presence of noise remains an open problem in general. In this talk, we provide such a characterization for the task of sparsity pattern estimation (also known as support recovery). Using tools from information theory, we find a sharp separation into two problem regimes – one in which the problem is fundamentally noise-limited, and a more interesting one in which the problem is limited by the behavior of the sparse components themselves. This analysis allows us to identify settings where existing computationally efficient algorithms, such as the LASSO, are optimal as well as other settings where these algorithms are highly suboptimal. Furthermore, we show how additional structure can make a key difference, analogous to the role of diversity in wireless communications.

On the engineering side, our analysis answers key engineering questions related to compressed sensing: Is it better to increase SNR or take more measurements? Is a given algorithm good enough? What accuracy can be attained? On the mathematical side, our results validate certain phase transitions predicted by the powerful, but heuristic, replica method from statistical physics.

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Biography

Galen Reeves is a VIGRE Postdoctoral Scholar in the Department of Statistics, Stanford University, working with David Donoho. He received the B.S. degree in electrical and computer engineering from Cornell University in 2005 and the M.S. and Ph.D. degrees in electrical engineering and computer sciences from the University of California at Berkeley in 2007 and 2011 respectively. In the Summer of 2011 he was a postdoctoral researcher in the School of Computer and Communication Sciences, EPFL, working with Michael Gastpar. His his research interests include compressed sensing, statistical signal processing, information theory, and machine learning.