University of Rochester
Department of Electrical and Computer Engineering Colloquia

Dynamic Robust PCA

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12:00 PM – 1:00 PM
Computer Studies Building (CSB) 209

Abstract: A significant fraction of data generated by various sources in the current big data age is of a "streaming" nature which can either not be stored or not be stored for too long. Examples include texts, tweets, network traffic, changing Facebook connections, or video surveillance feeds coming in from one or multiple cameras. A crucial first step in working with these big datasets is to clean them up by performing noise/outlier removal and dimensionality reduction. Traditionally, this is done by solving the principal components' analysis (PCA) problem. While PCA is a classical well studied problem, traditional techniques fail if the data is corrupted by anything other than small noise. However, very often, a lot of current datasets are highly noisy and corrupted by large magnitude but sparse outliers. Moreover, in many cases, dynamic algorithms are needed either because decisions are needed in real-time, or because the data subspace itself changes with time and needs to be updated on-the-fly. This problem of tracking the low dimensional subspace, in which a given dataset lies, in the presence of sparse outliers is referred to as dynamic robust PCA. While the static robust PCA problem has received a lot of attention in recent literature, the dynamic problem is largely open. In a recent body of work, we have introduced the first provably correct and practically usable solution framework to dynamic robust PCA called Recursive Projected Compressive Sensing (ReProCS). Its significant advantage over other robust PCA based methods has been demonstrated both for video layering and for video denoising and enhancement. This work also has many applications beyond video analytics such as recommendation system design, collaborative filtering, detection of anomalous behavior in dynamic social networks, etc, and these will be discussed too. We will end the talk by also talking about two other ongoing projects, both of which also involve PCA. The first is correlated-PCA, i.e., PCA when data and noise are correlated. We encounter this problem in the subspace update of ReProCS. However, the problem is also of independent interest since almost all existing guarantees for PCA assume that the data and the noise are uncorrelated. The second is our work on low rank phase retrieval and phaseless PCA. This involves PCA (and low rank matrix recovery) from magnitude-only measurements of random linear projections of each column of a low-rank matrix. This has important applications in dynamic sub-diffraction imaging and ptychography, among others. Exciting preliminary experimental results will be shown.

Bio: Namrata Vaswani received a B.Tech. from the Indian Institute of Technology (IIT-Delhi), in 1999, and a Ph.D. from the University of Maryland, College Park, in 2004, both in Electrical Engineering. During 2004-05, she was a postdoctoral fellow and research scientist at Georgia Tech. Since Fall 2005, she has been with the Iowa State University where she is currently a Professor of Electrical and Computer Engineering and (by courtesy) of Mathematics. Her research interests lie at the intersection of data science and machine learning for high dimensional problems, signal and information processing, and computer vision and bio-imaging. Her most recent work has been on provably correct and practically useful algorithms for online dynamic robust PCA, dynamic compressive sensing (sparse recovery), and phase retrieval. Prof. Vaswani has served one term as an Associate Editor for the IEEE Transactions on Signal Processing (2009-2012) and is currently serving her second term. She is a recipient of the Harpole-Pentair Assistant Professorship at Iowa State (2008-09), the Iowa State Early Career Engineering Faculty Research Award (2014) and the IEEE Signal Processing Society Best Paper Award
(2014) for her Modified-CS paper (that appeared in IEEE Trans. Sig. Proc. in Sept. 2010).

Pizza and soda provided.