University of Rochester
Department of Electrical and Computer Engineering Colloquia Series

L1-norm Principal-Component Analysis: New Options for Outlier-resistant Signal Processing and Learning

Dr. Panos Markopoulos

Wednesday, November 30th
12:00PM – 1:00PM
Computer Studies Building (CSB) 209

Abstract: Principal-Component Analysis (PCA) has been a mainstay of modern signal processing, machine learning, pattern recognition, and classification for more than a century. Numerous important applications of PCA can be found in the fields of wireless communications, computer networks, computer vision, image processing, bioinformatics/genomics, and neuroscience, to name a few. In the advent of the big-data era, datasets often include grossly corrupted, highly deviating, irregular data points (outliers), due to a variety of causes such as transient sensor malfunctions, errors in data transmission/transcription, and errors in training data labeling, to name a few. Regretfully, standard PCA is well-known to be very fragile in the presence of such faulty points, even when they appear in a vanishingly small fractions of the training set. The reason is that the L2-norm objective of standard PCA (minimization of error variance or maximization of squared projection magnitude) gives squared importance on the magnitude of every datum, thus overemphasizing peripheral data points. To remedy the impact of outliers, researchers from the fields of data analysis and signal processing have long focused on calculating subspaces of minimum absolute error deviations, instead of minimum error variances. Important early theoretical studies date back to the 1940s. In this talk, we will discuss L1-norm Principal-Component Analysis (L1-PCA), a L1-norm-based alternative to standard PCA that exhibits remarkable resistance against outliers in the processed data, while it attains performance almost identical to PCA when the processed data are nominal/corruption-free. Specifically, we will motivate the formulation of L1-PCA, discuss its hardness, and present its newly found optimal solution. In addition, we will summarize efficient algorithms for solving L1-PCA. We will conclude with numerical and experimental results on dimensionality reduction, sensor-array processing, and genomic data processing that illustrate the effectiveness of L1-PCA.

Bio: Dr. Panos P. Markopoulos was born in Athens, Greece, on August 29, 1986. He received the Diploma degree (5-year program) and M.Sc. degree (2-year program), both in Electronic and Computer Engineering, from the Technical University of Crete, Greece, in 2010 and 2012, respectively. Dr. Markopoulos received his Ph.D. degree in Electrical Engineering from University at Buffalo, The State University of New York, Buffalo, NY, in 2015. Since August 2015, he has been an Assistant Professor with the Department of Electrical and Microelectronic Engineering, Rochester Institute of Technology, and a Co-Director of the Communications Laboratory of the Kate Gleason College of Engineering. Dr. Markopoulos's research interests are in the areas adaptive signal processing, data analysis, and wireless communications, with applications to outlier-resistant data analysis and learning, learning from short training data, antenna arrays, and adaptive design of wireless transceivers for multiple-access and interference channels. Dr. Markopoulos is a member of the IEEE Signal Processing, Communications, and Computer Societies, as well as a member of the IEEE Technical Committee for Pattern Analysis and Machine Intelligence (IEEE Computer Society) and an Affiliate Member of IEEE Technical Com¬¬mittee on Sensor Array and Multichannel (IEEE Signal Processing Society). Dr. Markopoulos has served as reviewer to IEEE Transactions on Signal Processing, IEEE Transactions on Communications, IEEE Transactions on Multimedia, and IEEE Wireless Communications Letters. In 2017, Dr. Markopoulos is co-organizing the 1st IEEE International Workshop on Wireless Communications and Networking in Extreme Environments (IEEE WCNEE 2017). In August 2013, Dr. Markopoulos received the Best Paper Award of the 10th IEEE International Symposium on Wireless Communication Systems for the paper "Some options for L1-subspace signal processing."

Pizza and soft drinks will be provided!