Time: Monday May 2nd, 2011 4:30pm
Location: Buchanan A203

An Augmented Lagrangian Approach for Sparse Principal Component Analysis

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Principal component analysis (PCA) is a widely used technique for data analysis and dimension reduction with numerous applications in science and engineering. In essence, PCA aims at finding a few linear combinations of the original variables, called principal components (PCs), which point in orthogonal directions capturing as much of the variance of the variables as possible. However, the standard PCA suffers from the fact that the principal components (PCs) are usually linear combinations of all the original variables. To alleviate this drawback, various sparse PCA approaches were proposed in the literature. Despite success in achieving sparsity, some important properties enjoyed by the standard PCA are lost in these methods such as uncorrelation of PCs and orthogonality of loading vectors. In t! his talk we propose a new formulation for sparse PCA, aiming at finding sparse and nearly uncorrelated PCs with orthogonal loading vectors while explaining as much of the total variance as possible. We also develop a novel augmented Lagrangian method for solving a class of nonsmooth constrained optimization problems, which is well suited for our formulation of sparse PCA. The computational results demonstrate that the sparse PCs produced by our approach substantially outperform those by other methods in terms of total explained variance, correlation of PCs, and orthogonality of loading vectors.