MM Algorithms for Penalized Regression Problems

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The study of penalized objective functions in connection with high dimensional regression problems has increased dramatically in recent years. In problems where the goal is to simultaneously select variables and estimate regression coefficients in settings of relatively high dimension, the use of nondifferentiable penalty functions, such as the convex LÍ norm and concave SCAD and MCP penalty functions, have been proposed for this purpose. In the case of convex and concave penalty functions, substantial attention has been paid to the understanding of statistical behavior (e.g., oracle properties) of the resulting estimators; however, in the case of concave penalties, considerably less attention has been paid to the development of general algorithms with known convergence properties.

In this talk, I describe a general class of majorization minimization (MM) algorithms for this purpose. The resulting (M)inimization by (I)terated (S)oft (T)hresholding (ie, MIST) algorithm relies on iterated soft-thresholding, implemented componentwise, and is characterized by very fast, stable parameter updating that avoids the need to invert high-dimensional or otherwise numerically unstable matrices. We summarize the local convergence properties for this new class of algorithms, introduce some interesting variations designed specifically for penalized GLM regression problems, and evaluate performance for "raw" and "accelerated" versions of these methods. As an illustration, we propose a new algorithm for fitting Cox regression models subject to the MCP penalization recently introduced in Zhang (2008, 2010) and use it to analyze the relationship between gene expression data and survival in lymphoma patients.

This talk is based on joint work with Liz Schifano and Marty Wells (Electronic Journal of Statistics, 2010).