Pattern recovery by convex non-differentiable regularizers

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Abstract

Convex non-differentiable regularization is usually associated with sparsity, but its scope is much broader. Many such penalties promote structured low-dimensional patterns in the parameter space, including sparsity, clustering, and fusion. In this talk, I will present a general framework in which the notion of pattern is characterized through the geometry of the subdifferential of the penalty. This perspective helps explain how regularization induces interpretable structure and why it can improve estimation, not only by reducing complexity, but also by shrinking the estimator toward a lower-dimensional pattern space.

Such shrinkage can lead to a substantial reduction in variance and, consequently, to improved estimation accuracy, especially when the underlying signal indeed possesses a simple latent structure. I will discuss theoretical results showing when these patterns can be consistently recovered and how pattern recovery differs from the more classical goals of estimation and prediction. The asymptotic analysis of the pattern convergence requires tools going beyond standard asymptotic theory and leads to conditions for pattern recovery that are closely related to irrepresentability-type phenomena. Examples based on fused LASSO and SLOPE will illustrate how convex regularization can recover meaningful structure beyond variable selection alone.