Sparse and smooth solutions for learning and inverse problems

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Abstract

We consider learning and inverse problems formulated in terms of the minimization of a least-squares loss or discrepancy with combined smoothness and sparsity-enforcing penalties. The smoothness penalty is of the usual quadratic type used in classical regularization theory whereas the sparsity-enforcing penalty involves the ℓ^1-norm of the sequence of the solution coefficients on a given basis or frame. The use of both penalties together allows to select sparse blocks of correlated coefficients (variables). We analyze the properties of the regularized solutions derived within such scheme and describe iterative algorithms allowing to compute such solutions. We derive regularization theorems which apply to inverse problems with errors in the data and in the operator as well as probabilistic consistency results which apply to learning theory. Potential fields of applications for these results are also outlined.