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1. Bayesian modelling in wavelet nonparametric regression: a priori Besov regularity properties; optimality.

   Derivation of the necessary and sufficient conditions for a very general class of random wavelet representations to belong to a Besov space, both for orthogonal wavelet and for a wavelet frame decompositions. They can be used to interpret a priori assumptions in wavelet domain in terms of Besov regularity properties.

   Pointwise optimality of Bayes Factor wavelet regression estimators in ℓ_p norm, with minimax rates of convergence, under power exponential and heavy tailed priors (with T.Sapatinas).

2. Sparse regression

   The problem of compound decision making is considered, with the aim of obtaining sparse estimates of a group of vectors. We raise the issue of different scenarios of sparsity between the groups, and consider 3 different estimators designed for the 3 main sparsity patterns: fully dependent, fully independent and where the sparsity is achieved in some different basis. In the latter case the basis can be adaptively estimated, as we show in the context of functional data analysis. Non-asymptotic bounds characterising different types of performance of these estimators are derived (with Y. Ritov).

3. Performance of Bayesian estimators in inverse problems

   The setting is an ill-posed linear inverse problem with non-Gaussian errors where the prior distribution is chosen to identify a smooth solution of interest. Output of a Bayesian model is the posterior distribution which, in addition to a point estimate (e.g. maximum a posteriori estimator that can be interpreted as the minimiser of the corresponding penalised loss), also reports its uncertainty. To assess the performance of the estimator, we derive oracle inequalities for the Ky Fan distance between the solution of interest and the posterior distribution as a function of data (and hence as a random variable). The approach is illustrated on an emission tomography example (with P.Green).

4. Wavelet goodness-of-fit test for dependent observations.

   GoF test for data under the assumption of stationarity is proposed, with known covariance function. Interestingly, the proposed method also works for testing hypothesis about unknown correlation function under weak assumptions, if the marginal distribution is known. The method is applied to find a local approximation for Riemann's zeta function on the critical line.

5. Modelling of functional genomics data (microarrays, 2D gels proteomics, metabolic NMR spectra)

   Formalisation of classification rules for high dimensional data often used under Bayesian hierarchical models, from the point of view of decision theory (with A.Lewin).

   Proposed a method to check the model fit for a Bayesian model with mixture prior for high dimensional data (with A. Lewin, S. Richardson).

6. Sparse additive regression models.