Sparse Bayesian Modeling with Spike and Slab Priors

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Sparse modelling and variable selection is one of the most important issues in regression type models, as in applications often a large number of covariates on comparably few subjects are available. Estimation of regression effects in such *large p, small n* problems is ill-conditioned: estimated regression effects typically have large standard errors, estimation results are instable and fitted models have no good predictive performance. To identify those regressors which have a non-negligible effect, many methods have been developed. In a Bayesian approach variable selection methods often rely on specifying spike and slab priors on the regression effects. These priors are mixtures of two components: the spike is centered at zero with very small variance and the slab is comparably flat. The finite mixture structure allows classification of effects as (practically) zero and non-zero. Bayesian estimation can be performed by MCMC methods and is rather straightforward when spikes are specified as continuous distributions.

More recently spike and slab priors have been employed beyond standard regression models to achieve sparsity in more complex models, e.g. in random effects or state space models. Using spike and slab priors also on variance and covariance parameters allows to start with a rather flexible model, e.g. in state space models with time-varying effects of all potential regressors and classify effects as zero, constant or varying over time during estimation.

This talk reviews Bayesian modelling with spike and slab priors in various model classes and discusses potential further applications.