Bayesian Dynamic Fused LASSO

Kaoru Irie

Faculty of Economics, The University of Tokyo

The new class of Markov processes is proposed to model the flexible shrinkage effects in the prior of time-varying parameters for time series analysis. The transition density of the new process consists of two penalty functions, similar to Bayesian fused LASSO in its functional form, that shrink the current state variable to its previous value and zero. The normalizing constant of this density, which is not ignorable in the posterior computation, is shown to be essentially the log-geometric mixture of double-exponential densities and treated as a part of the likelihood. The dynamic regression models with this new process used as a prior is conditionally Gaussian and linear in state variables, for which the posterior can be computed efficiently by the forward filtering and backward sampling in Gibbs sampler. The latent variable that follows the log-geometric distribution is understood as the amount of shrinkage to zero realized in the posterior and can be used to detect periods in which the corresponding dynamic coefficient becomes inactive. The new prior is compared with the standard double-exponential prior in the estimation of, and prediction by, the dynamic linear models by using simulated datasets for illustration. It is also applied to the time-varying vector autoregressive models for the US macroeconomic data, which exemplifies the use of the new prior as an alternative of the dynamic model of variable selection type, such as the latent threshold models.

Key words and phrases: Dynamic shrinkage, Bayesian fused LASSO, dynamic linear models, forward filtering and backward sampling, scale mixture of normals, synthetic likelihoods.

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