Exploring spatial dynamics in regression coefficients: A Bayesian regularization method with clustering

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Analyzing datasets with spatial information in regression setting often challenges the assumption that the relationship between the response variable and explanatory variables remains homogeneous across the spatial domain. To relax such assumption, we propose a Bayesian Regularized Spatially Clustered Coefficient model, which detects cluster-wise varying effects and performs variable selection simultaneously. The proposed model identifies key covariates influencing the response variable by introducing a selection prior and uncovers their spatially clustered coefficient effects using a clustering prior. Bayesian inference is implemented via the Reversible Jump Markov chain Monte Carlo (RJMCMC) method, utilizing two types of reversible jump moves that enable efficient exploration of the parameter space. The collapsed posterior and parallel tampering are also considered for better mixing of the RJMCMC samples. A simulation study was conducted under various settings to demonstrate the effectiveness of the proposed approach. Finally, our model was applied to real data from the 19th and 20th presidential elections in South Korea to identify factors influencing the vote share of the elected president and to examine their spatial cluster-specific effects, as the data exhibit strong spatial dependence driven by the pronounced regional characteristics of political preferences.