Bayesian regression models for complex spatially or serially correlated functional data

Prof. Dr. Jeffrey S. Morris
(The University of Texas M.D. Anderson Cancer Center)

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A series of Bayesian regression modeling strategies that can be used for spatially or longitudinally correlated functional data will be described. The methods are intended for use with complex functional data, measured on fine grids and with complexities including multi-dimensional and possibly non-Euclidean domains, local features like changepoints and peaks, and sampled on high-dimensional fine grids. Intrafunctional correlation is handled through basis function modeling, while interfunctional correlation is captured by one of three approaches: (1) parametric or nonparametric random effect functions, (2) separable or non-separable spatial (or temporal) inter-functional processes, or (3) tensor-basis function modeling. Rigorous Bayesian inference is done in such a way that adjusts for any potential multiple testing issues. We will describe these general approaches and illustrate them on a series of complex, high-dimensional, spatially and longitudinally correlated functional data sets coming from strain tensor data from a glaucoma study, bladder cancer genomic maps, event-related potential data from a smoking cessation study. We will also discuss recent work in which we have developed spatiotemporal quantile functional regression approaches that we are applying to model temporal climate change in terms of intraseasonal temperature and precipitation distributions. Full Bayesian infererence is available for answering inferential questions while accounting for multiple testing according to experimentwise error rate and/or false discovery rate criteria. These methods are encapsulated within the BayesFMM package of general Bayesian functional mixed models, for which we are developing general software in R and Matlab.