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Bayesian Functional Generalized Additive Models with Sparsely Observed Covariates

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The functional generalized additive model (FGAM) was recently proposed in McLean et al. (2012) as a more flexible alternative to the common functional linear model (FLM) for regressing a scalar on functional covariates. In this paper, we develop a Bayesian version of FGAM for the case of Gaussian errors with identity link function. Our approach allows the functional covariates to be sparsely observed and measured with error, whereas the estimation procedure of McLean et al. (2012) required that they be noiselessly observed on a regular grid. We consider both Monte Carlo and variational Bayes methods for fitting the FGAM with sparsely observed covariates. Due to the complicated form of the model posterior distribution and full conditional distributions, standard Monte Carlo and variational Bayes algorithms cannot be used. The strategies we use to handle the updating of parameters without closed-form full conditionals should be of independent interest to applied Bayesian statisticians working with nonconjugate models. Our numerical studies demonstrate the benefits of our algorithms over a two-step approach of first recovering the complete trajectories using standard techniques and then fitting a functional regression model. In a real data analysis, our methods are applied to forecasting closing price for items up for auction on the online auction website eBay.

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