

We consider a nonlinear function-on-function additive regression model with multiple functional predictors. The forms of the nonlinear functions are unspecified, which offer great flexibility to model various relationships between the response curve and predictor curves. We clarify the identifiability issue of the model and identify the best decompositions of the nonlinear functions in the model in terms of prediction. To estimate this expansion, we solve a penalized functional generalized eigenvalue problem followed by a penalized least squares procedure. Because of the minimum prediction error of the proposed decomposition, our approach has good prediction accuracy. In addition, our approach converts the estimation of three-dimensional nonlinear functions to the estimation of two-dimensional functions, which considerably reduces computational costs. Asymptotic results are provided, and simulations and a real data application show that the proposed method has good predictive performance and is efficient in dimension reduction and computation.