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Title: Penalized Functional Regression

Abstract: As technologies for the collection and storage of large data sets have advanced, statistical applications involving medical images have become increasingly common. This has been accompanied by the development of regression models in which one or more of the covariates is a function. Motivated by a diffusion tensor imaging (DTI) study of multiple sclerosis patients, we develop a novel inferential approach to generalized functional regression models based on a mixed effects framework which 1) is highly automated and computationally efficient; 2) is widely applicable, including to functions that are observed on sparse grids or with error; and 3) allows for the ready construction of confidence intervals for the functional coefficient. Finally, we generalize the penalized functional regression framework to the longitudinal setting, in which distinct functional predictors are observed for subjects across multiple visits.