

Superconsistent estimation of points of impact in non-parametric regression with functional predictors

Dominik Poß, Dominik Liebl and Alois Kneip,

University of Bonn, Germany

Hedwig Eisenbarth,

Victoria University of Wellington, New Zealand

Tor D. Wager

Dartmouth College, Hanover, USA

and Lisa Feldman Barrett

Northeastern University, Boston, Massachusetts General Hospital and Harvard Medical School, Boston, and Massachusetts General Hospital, Charlestown, USA

[Received May 2019. Final revision May 2020]

Summary. Predicting scalar outcomes by using functional predictors is a classical problem in functional data analysis. In many applications, however, only specific locations or time points of the functional predictors have an influence on the outcome. Such ‘points of impact’ are typically unknown and must be estimated in addition to estimating the usual model components. We show that our points-of-impact estimator enjoys a superconsistent rate of convergence and does not require knowledge or pre-estimates of the unknown model components. This remarkable result facilitates the subsequent estimation of the remaining model components as shown in the theoretical part, where we consider the case of non-parametric models and the practically relevant case of generalized linear models. The finite sample properties of our estimators are assessed by means of a simulation study. Our methodology is motivated by data from a psychological experiment in which the participants were asked to rate their emotional state continuously while watching an affective video eliciting a varying intensity of emotional reactions.

Keywords: Emotional stimuli; Functional data analysis; Non-parametric regression; On-line video rating; Quasi-maximum-likelihood; Variable selection