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Penalized likelihood regression for generalized linear models with non-quadratic penalties

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Abstract One of the popular method for fitting a regression function is regularization: minimizing an objective function which enforces a roughness penalty in addition to coherence with the data. This is the case when formulating penalized likelihood regression for exponential families. Most of the smoothing methods employ quadratic penalties, leading to linear estimates, and are in general incapable of recovering discontinuities or other important attributes in the regression function. In contrast, non-linear estimates are generally more accurate. In this paper, we focus on non-parametric penalized likelihood regression methods using splines and a variety of *non-quadratic* penalties, pointing out common basic principles. We present an asymptotic analysis of convergence rates that justifies the approach. We report on a simulation study including comparisons between our method and some existing ones. We illustrate our approach with an application to Poisson non-parametric regression modeling of frequency counts of reported acquired immune deficiency syndrome (AIDS) cases in the UK.

Keywords Denoising · Edge-detection · Generalized linear models · Non-parametric regression · Non-convex analysis · Non-smooth analysis · Regularized estimation · Smoothing · Thresholding