

STATISTICAL ANALYSIS AND DATA MINING

Original Article

Regression on manifolds using data - dependent regularization with applications in computer vision

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Abstract

Various issues arise in performing regression and classification when one uses images as predictors, chief among them high dimensionality. Considering a naïve approach in which each pixel is entered into the model as a separate predictor, the analysis quickly becomes unwieldy, since modern cameras can output pictures with pixels numbering on the order of millions. However, images are highly constrained; the intrinsic dimension of an image is often far less than its ambient dimension. Moreover, various techniques to obtain new predictors (e.g., via feature extraction or by considering sets of predefined salient points in each image as variables in a regression model) can further reduce the dimension of the predictors, giving rise to an inherent lower - dimensional, manifold structure. We show that, for some regression problems in computer vision, using a data - dependent regularization that implicitly considers this manifold structure yields improvements over numerous alternatives. We extend this method to cases in which the structure is known *a priori*, in which it outperforms alternative methods, including those which explicitly take the known structure into account. © 2013 Wiley Periodicals, Inc. Statistical Analysis and Data Mining, 2013

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