Sparse Dictionary Learning

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Résumé

In many fields such as microscopy, astronomy, spectroscopy or imaging, signals that appear naturally have the structure of a sparse linear combination of parametric functions belonging to a continuous dictionary. We observe noisy measurements of such a signal discretely at given time points or continuously on a given interval and suppose that the noise level is known. The noise is supposed Gaussian and we treat simultaneously the discrete and continuous cases. We want to recover both the coefficients of the linear combination and the parameters of the functions involved. One of the first questions is whether it is possible to retrieve all the underlying parameters from the sole observation of the signal. When the parameters of the parametric functions are known the model becomes the sparse high-dimensional linear regression model. In our work we assume that the parametric functions belong to a continuous dictionary and consider therefore a highly non-linear extension of the linear regression model. In order to retrieve all the parameters in the model we formulate a regularized optimization problem, which despite its non-convex nature can be solved in a satisfactory way by numerical methods. Our work focuses on the behaviour of the estimators defined via the optimization problem with respect to the information we have on the signal.

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