High dimensional regression with Gaussian mixtures and partially latent response variables: Application to hyper-spectral image analysis

Florence Forbes*[1]

[1]MISTIS (INRIA Grenoble Rhône-Alpes / LJK Laboratoire Jean Kuntzmann) – Laboratoire Jean Kuntzmann, INRIA – France

Résumé

This is joint work with Antoine Deleforge and Radu Horaud INRIA Grenoble Rhône-Alpes.

Abstract: The analysis of hyper-spectral images often involves to solve an inverse problem to deduce a number of physical parameter values from the observed spectra. This inverse problem typically involves a high-dimensional regression that cannot generally be solved directly. To address this issue, the use of training approaches have been considered with the advantage that, once a relationship between physical parameters and spectra has been established trough training, the learnt relationship can be used for very large datasets and for all new images underpinned by the same physical model. Within this category of methods, we propose an inverse regression method which exchanges the roles of the input variable (high-dimensional spectrum) and the response variable (low-dimensional physical parameter vector). We introduce a mixture of locally-linear probabilistic mapping model that starts with estimating the above inverse regression, and from which we can deduce closed-form solutions for the forward high-dimensional regression problem of interest. Moreover, we introduce a partially-latent paradigm, such that the vector-valued response variable is composed of both observed and latent entries, thus being able to deal with physical parameters that cannot be observed or, more generally, with data contaminated by experimental artifacts that cannot be explained with noise models. The proposed probabilistic formulation could be viewed as a latent-variable augmentation of regression. We devise expectation-maximization (EM) procedures which facilitate the maximum-likelihood search over the model parameters. The proposed framework is illustrated on real data from the Mars ground collected from the imaging spectrometer OMEGA instrument.

*Intervenant