High dimension regression with applications

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This subject could be followed by a PhD thesis

The task of regression consists of learning a mapping from an input variable onto a response variable, such that the response of a test point could be easily and robustly computed. While this problem has been extensively studied, situations where the input variable is of high dimension, and where the response variable may not be fully observed, still challenge the current state of the art. It is well known that high-dimensional to low-dimensional regression is problematic, and usually performed in two separated steps: dimensionality reduction followed by regression.

In this work, starting from standard mixture of linear regressions, we proposed a novel mixture of locally-linear regression model that unifies regression and dimensionality reduction into a common framework. The probabilistic formulation that we derived may be seen as a latent-variable augmentation of regression [Deleforge et al, Stat & Computing, 2014]. The approach compares favorably to a number of existing regression techniques and was apply to the retrieval of Mars surface physical properties from hyperspectral images and sound source separation.
The model is available in Matlab : \url{https://team.inria.fr/perception/gllim_toolbox/}.

The goal of the proposed investigation is to study the applicability of the model and its possible extensions to other domains and data sets. In particular we would like to further develop the use of the model :

1) for hyperspectral imaging using two other real data sets,
2) for medical image segmentation using a synthetic data set, to address the issue of partial volume estimation
3) for robotics applications including navigation of a robot in a real worl environnement based on the analysis of stereo data.

References :

Deleforge, F. Forbes and R. Horaud, High-Dimensional Regression with Gaussian Mixtures and Partially-Latent Response Variables. Statistics and Computing.

A. Deleforge, F. Forbes and R. Horaud, Hearing on binaural manifolds: acoustic space learning for sound-source separation and localization. International Journal of Neural Systems. 2014

Deleforge, F. Forbes and R. Horaud, Hyper-spectral Image Analysis with Partially-Latent Regression. EUSIPCO (European Signal Processing Conference), Lisbon, Portugal, Sept. 2014.

Prerequisites : Statistics and signal and image processing . Skills in programming .