Abstract

In this thesis, our main interest is the modeling and the prediction of time series with joint use of multilayer perceptron (MLP) and hidden Markov chain (HMM).

After recalling some fundamental results on MLP, we empirically discuss how to use simulated annealing to initialize the estimation of the parameters (weights) of MLP. Next, we study the estimation of parameters for autoregressive model in the context of multidimensional time series. We show that the contrast function to minimize is the logarithm of the determinant of the empirical covariance matrix because it matches with the maximum likelihood method for a Gaussian noise. We show that, under good regularity conditions on the model and without normality assumption on the noise, this contrast function has good statistical properties, moreover we deduce that a penalized contrast like BIC is strongly consistent under mild assumptions.

Then we study the hybrid model HMM/MLP or autoregressive models with Markov switching. We show that these models have good properties on the laser laboratory series. Then we study the different ways to estimate the parameters of the model with the maximum likelihood method (MLE). Generalizing the Elliott's method, we propose an expectation-maximization (E.M) algorithm with only a forward recurrence. This methods yields us an on-line implementation of the algorithm. Then we show that a direct method based on effective calculus of the derivative of the log-likelihood yields a better algorithm.

Lastly, we study the statistical properties of the MLE. After recalling the conditions for a stationary solution generated by this model, we show the strong consistency and the asymptotic normality of this estimator. Finally we use this model for improving the previsions of ozone pollution level in the Parisian atmosphere.

Key words : Markov chains, non-linear autoregressive models, M-estimators, almost sure identification, asymptotic statistic, adaptative algorithm.