Estimation of local independence graphs via Hawkes processes to unravel functional neuronal connectivity*

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Abstract

We will present an adaptation of the Least Absolute Shrinkage and Selection Operator LASSO method to the analysis of correlation dynamics of small neuronal populations. Indeed, due to its low computational cost, Lasso is an attractive regularization method for high dimensional statistical settings. Within our framework, we consider multivariate counting processes depending on an unknown function parameter to be estimated by linear combinations of a fixed dictionary. To select coefficients, we propose an adaptive ℓ_1 penalty, where data-driven weights are derived from new Bernstein type inequalities for martingales. Oracle inequalities are established under assumptions on the Gram matrix of the dictionary. This method is then applied to Hawkes processes as model for spike train analysis. The estimation allows us to recover the functional underlying connectivity as the local dependence graph that has been estimated. Simulations and real data analysis show the excellent performances of our method in practice.

*Machine Learning External Seminar, Gatsby Unit, November 2, 2015.