Prof. Dr. Rainer von Sachs: A multiscale approach for statistical characterization of functional images

Abstract:
In this paper we use an approach of spatial multiscales for an improved characterization of functional pixel intensities of images. Examples are numerous such as temporal dependence of brain response intensities measured by fMRI or frequency dependence of NMR spectra measured at each pixel. The overall goal is to improve the misclassification rate in clustering (unsupervised
learning) of the functional image content into a finite but unknown number of classes. Hereby we adopt a non-parametric point of view to reduce the functional dimensionality of the observed pixel intensities, modelled to be of a very general functional form, by a combination of "aggregation" and truncation techniques. Clustering is applied via an EM-algorithm for estimating a Gaussian mixture model in the domain of the discrete wavelet transform of the pixel intensity curves. We show improvements of our multiscale method, based on complexity-penalised likelihood estimation for Recursive Dyadic Partitioning of the image, over existing monoscale approaches, by simulated and real data examples, and we give some theoretical treatment of the resulting misclassification rate in the simplified set-up of the "horizon" model of two classes.

This is joint work with A. Antoniadis (Grenoble) and J. Bigot (Toulouse).

Keywords: Mixture model; Recursive dyadic partition; Multiresolution trees; Aggregation; Wavelets.