Optimal experimental designs for functional magnetic resonance imaging

Bärbel Maus (Department of Methodology and Statistics, Maastricht University)

September 23, 2011

Functional magnetic resonance imaging (fMRI) is a non-invasive neuro-imaging method used to study human brain activity in response to mental stimuli, e.g. pictures of faces or houses. To perform an fMRI experiment, a stimulus sequence of experimental stimuli has to be chosen for presentation to the subject in the MRI scanner. This chosen stimulus sequence for an fMRI experiment should be efficient for estimation of the effects of interest. In my PhD thesis I used optimal design methods to find efficient fMRI experiments depending on the research question of interest. The A- and D-optimality criteria were applied to evaluate the efficiency of a design sequence based on relevant linear and nonlinear models with autoregressive error in fMRI data analysis. The search in the enormous space of possible stimulus sequences was performed by a genetic algorithm using the A- or D-optimality criterion. The maximin criterion was used to handle local optimality on the model parameters, e.g. the autocorrelation parameter in a first –order autoregressive error. Conclusions about the characteristics and robustness of an optimal experimental fMRI design are drawn based upon my results.