Optimal design for functional magnetic resonance imaging experiments based on linear models

Baerbel Maus, Gerard J. P. van Breukelen, Rainer Goebel, and Martijn P. F. Berger

Maastricht University, The Netherlands

Abstract

Functional magnetic resonance imaging is a neuroimaging method which is used to study the human brain and its functional areas. In the first part of this presentation it will be shown how the general linear model is used to describe experimental functional magnetic resonance imaging (fMRI) data from one subject (Friston, Holmes, Poline, Grasby, Williams, Frackowiak and Turner, 1995). Based on the general linear model, optimal designs for one-subject fMRI experiments can be obtained by application of the D- and A-optimality criterion (Atkinson, Donev and Tobias, 2006; Maus, van Breukelen, Goebel and Berger, 2010). Because of the huge design space for fMRI experiments, a genetic algorithm (GA) is employed to find optimal designs for fMRI experiments based on a multi-objective design criterion (Kao, Mandal, Lazar and Stufken, 2009; Maus, van Breukelen, Goebel and Berger, 2010; Wager and Nichols, 2003).

The second part of the presentation will focus on the application of mixed effects models in analysis of fMRI experiments from multiple subjects (Holmes and Friston, 1998). Optimal designs for multi-subject experiments are considered and the optimal combination of number of subjects and fMRI scanner time/imaging time per subject will be studied with respect to a linear cost function.

Keywords

Optimal design of experiments, fMRI, General linear model, Mixed effects model.

References

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