Signal detection in ERP data by decorrelated functional Analysis of Variance

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Event-related potentials (ERP) are voltage changes along the scalp time-locked to some physical or mental occurrence in the ongoing electrical brain activity recorded as electroencephalogram (EEG). Unlike functional magnetic resonance imaging (fMRI), ERPs studies provide better temporal resolution to chart the time course of mental processes.

In ERP experiments, the biomedical response of a subject to a drug dose or to a control/treatment group membership is a high resolution curve describing his differential brain activity along time. Measuring each effect size by a trustable p-value can be achieved using functional Analysis of Variance (fANOVA) model, which can just be viewed as an extension of traditional Analysis of Variance to the situation where the response is a curve.

As reported in Sheu *et al.* (2016), ERP data show a pronounced time-dependence, with time intervals of highly correlated ERPs. For the signal identification issue, Sheu *et al.* (2016) show that this strong time dependence induces instability of the selection procedure. They propose a method based on a flexible latent factor model for the time dependence to decorrelate ERP data while preserving the underlying true signal. Similarly, the present PhD project aims at investigating the consequences of strong time-dependence patterns for the signal detection issue by fANOVA likelihood-ratio tests.

References

[1] Bugli, C. and Lambert, P. (2006). functional ANOVA with random functional effects: an application to event-related potentials modelling for electroencephalograms analysis. *Statistics in Medicine*. **25**, 3718-3739.

[2] Sheu, C.F., Perthame, E., Lee, Y.S. and Causeur, D. (2016) Accounting for time dependence in large-scale multiple testing of event-related potential data. *Annals of Applied Statistics*. **10**(1), 219-245.