Revisiting random effect analysis of multi-subject fMRI studies

Jonathan Rosenblatt

Random Effects analysis has been introduced into fMRI research in order to generalize findings from the study group to the whole population. Generalizing findings is obviously harder than detecting activation in the study group since in order to be significant, an activation has to be larger than the inter-subject variability. Indeed, detected regions are smaller when using random effect analysis versus fixed effects. The statistical assumptions behind the classic random effects model are that the location-wise effect is normally distributed over subjects, and ``activation'' refers to a non-null mean effect. We argue this model is unrealistic and conservative compared to the true population variability.
We propose a finite-Gaussian-mixture--random-effect, at each brain location, in order to capture brain plasticity and registration anomalies. This model suggests a natural quantification of "activation" using the prevalence of activation over subjects. We present the estimation of this prevalence, and discuss the inference problem.