

Multiple Testing via FDR_L for Large Scale Imaging Data

Research on false discovery rate (FDR) procedures has gained increasing popularity in the past decade, due to its wide applications in many important areas. In Zhang, Fan and Yu (2011) (the Annals of Statistics, Volume 39, Number 1, pp 613-642), we proposed an FDR_L procedure which is specialized in detecting the presence of signals for large scale imaging data with spatial structures, widely collected in application areas such as astrophysics, satellite measurement and brain imaging. It has been demonstrated in our paper that compared with conventional FDR procedures, the proposed method has better statistical power while getting false discovery rate controlled. Figure 1 below compares the detected results of the activated brain areas between our method and a conventional FDR procedure with the real fMRI brain data (here, only one axial slice of the whole brain is displayed).

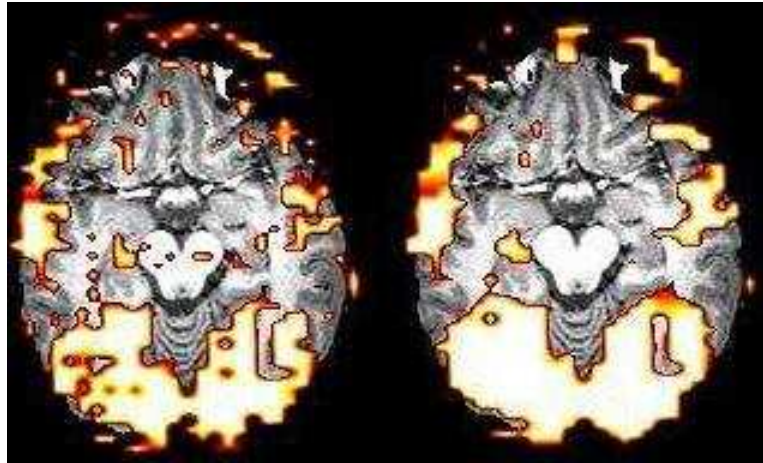


Figure 1: *Comparison of detected activated brain areas with the real fMRI data. Left panel - conventional FDR; right panel - FDR_L . The FDR control level is 0.01.*

Furthermore, in this paper, we raised one frequently encountered problem in FDR approaches, namely the lack of identification phenomenon (LIP). We demonstrated by both numerical studies and theory that by incorporating spatial information, the proposed FDR_L method is capable of effectively alleviating the LIP problem, and therefore providing more desirable detected results particularly for imaging data with spatial structures.