Independent vector analysis for capturing common components in fMRI group analysis

Independent component analysis (ICA) is a widely used blind source separation method for decomposing resting state functional magnetic resonance imaging (rs-fMRI) data into latent components. However, it can be challenging to obtain subject-specific component representations in multi-subject studies. Independent vector analysis (IVA) is a promising alternative approach to perform group fMRI analysis, which has been shown to better capture components with high inter-subject variability. The most widely applied IVA method is based on the multivariate Laplace distribution (IVA-GL), which assumes independence within subject components coupled across subjects only through shared scaling. In this study, we propose a more natural formulation of IVA based on a Normal-Inverse-Gamma distribution (IVA-NIG), in which the components can be directly interpreted as realizations of a common mean component with individual subject variability. We evaluate the performance of IVA-NIG compared to IVA-GL and similar decomposition methods, through the application of two types of simulated data and on real task fMRI data. The results show that IVA-NIG offers superior detection of components in simulated fMRI data. On real fMRI data with low inter-subject variability we find that all methods identify similar and plausible components.
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