## Independent Component Analysis Involving Autocorrelated Sources with an Application to Functional Magnetic Resonance Imaging

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## Abstract

Independent component analysis (ICA) is an effective data-driven method for blind source separation. It has been successfully applied to separate source signals of interest from their mixtures. Most existing ICA procedures are carried out by relying solely on the estimation of the marginal density functions, either parametrically or nonparametrically. In many applications, the correlation structures within each source signal also play an important role besides the marginal distributions. One important example is functional magnetic resonance imaging (fMRI) analysis where the brain-function-related signals are temporally correlated.

In this paper, we consider a novel approach to ICA that fully exploits the correlation structures within the source signals. Specifically, we propose to estimate the spectral density functions of the source signals instead of their marginal density functions. This is made possible by virtue of the intrinsic relationship between the (unobserved) sources and the (observed) mixed signals. Our methodology is described and implemented using spectral density functions from frequently used time series models such as autoregressive moving average (ARMA) processes. The time series parameters and the mixing matrix are estimated via maximizing the Whittle likelihood function. We illustrate the performance of the proposed method through extensive simulation studies and a real fMRI application. The numerical results indicate that our approach outperforms several popular methods including the most widely used fastICA algorithm.