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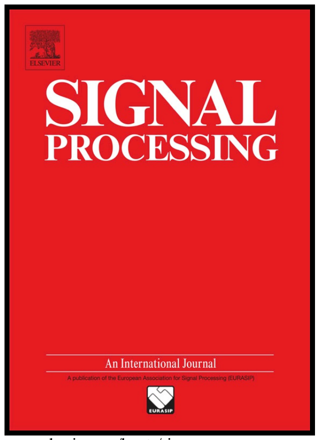

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A Bayesian Non-Parametric Hidden Markov Random Model for Hemodynamic Brain Parcellation

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Abstract

Deriving a meaningful functional brain parcellation is a very challenging issue in task-related fMRI analysis. The joint parcellation detection estimation model addresses this issue by inferring the parcels from fMRI data. However, it requires a priori fixing the number of parcels through an initial mask for parcellation. Hence, this difficult task generally depends on the subject. The proposed automatic parcellation approach in this paper overcomes this limitation at the subject-level relying on a Dirichlet process mixture model combined with a hidden Markov random field to estimate the parcels and their number online. The proposed method adopts a variational expectation maximization strategy for inference. Compared to the model selection procedure in the joint parcellation detection estimation framework, our method appears more efficient in terms of computational time and does not require finely tuned initialization. Synthetic data experiments show that our method is able to estimate the right model order and an accurate parcellation. Real data results demonstrate the ability of our method to aggregate parcels with similar hemodynamic behaviour in the right motor and bilateral occipital cortices while its discriminating power is increased compared to its ancestors. Moreover, the obtained HRF estimates are close to the canonical HRF in both cortices.

Keywords: fMRI, hemodynamic parcellation, VEM, Dirichlet process mixture model, Non-parametric Bayesian, HMRF

1. Introduction

Functional magnetic resonance imaging (fMRI) is a non-invasive imaging technique that indirectly measures neural activity from the blood-oxygen-level dependent (BOLD) signal (Ogawa et al., 1990). This signal reflects the variations in the blood oxygenation level induced by oxygen consumption of neural

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