Mean Field Approximation for BSS of images with a compound hierarchical Gauss-Markov-Potts model

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Abstract

In this paper we consider the Blind Source Separation (BSS) of images whose prior distributions are modeled through a compound Gauss-Markov modeling with a hidden classification labels modeled with a Potts distribution. This model is a powerful tool for modeling the images which are composed of homogeneous regions.
The joint estimation of the sources, classification labels, the mixing matrix and all the hyperparameters of the model (noise covariance, means and variances of the pixels in each region) can be done through the Gibbs sampling of the joint posterior probability law of these unknowns, given the observed mixed data. In previous works, we had implemented this general algorithm. However the huge complexity and cost of this posterior law limits its use in practical applications.
In this paper, we propose a Mean Field Approximation (MFA) approach which consists in approximating this joint posterior by a separable one whose sampling will be much easier and less expensive. Based on MFA, we propose new algorithms which look like the Stochastic Expectation-Maximization (SEM) to jointly separate and segment the image sources.

References:

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Key Words:

Blind Source Separation (BSS), Mean field approximation, Variational Bayesian Inference, Expectation-Maximization (EM), Gibbs sampling. Multi and hyperspectral image processing. Fourier Synthesis (FS), Inverse problems, Bayesian estimation, Hidden Markov Modeling (HMM), Markov Chain Monté Carlo (MCMC)