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Hybrid Algorithm for Non-Negative Matrix Factorization Based on Symmetric Kullback-Leibler Divergence for Signal Dependent Noise: A Case Study

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Abstract : Non-negative matrix factorization approximates a high dimensional non-negative matrix V as the product of two non-negative matrices, W and H, and allows only additive linear combinations of data, enabling it to learn parts with representations in reality. It has been successfully applied in the analysis and interpretation of high dimensional data arising in neuroscience, computational biology, and natural language processing, to name a few. The objective of this paper is to assess a hybrid algorithm for non-negative matrix factorization with multiplicative updates. The method aims to minimize the symmetric version of Kullback-Leibler divergence known as intrinsic information and assumes that the noise is signal-dependent and that it originates from an arbitrary distribution from the exponential family. It is a generalization of currently available algorithms for Gaussian, Poisson, gamma and inverse Gaussian noise. We demonstrate the potential usefulness of the new generalized algorithm by comparing its performance to the baseline methods which also aim to minimize symmetric divergence measures.

Keywords : non-negative matrix factorization, dimension reduction, clustering, intrinsic information, symmetric information divergence, signal-dependent noise, exponential family, generalized Kullback-Leibler divergence, dual divergence
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