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Blind source separation using block-coordinate relative Newton method

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ABSTRACT

Presented here is a generalization of the relative Newton method, recently proposed for quasi-maximum likelihood blind source separation. Special structure of the Hessian matrix allows performing block-coordinate Newton descent, which significantly reduces the algorithm computational complexity and boosts its performance. Simulations based on artificial and real data showed that the separation quality using the proposed algorithm is superior compared to other accepted blind source separation methods.

Keywords: blind source separation, block-coordinate optimization, quasi-maximum likelihood, Newton algorithm.

1. INTRODUCTION

The term *blind source separation* (BSS) refers to a wide class of problems in acoustics, medical signal and image processing, hyperspectral imaging, etc., where one needs to extract the underlying 1D or 2D sources from a set of linear mixtures without any knowledge of the mixing matrix. As a particular case, consider the problem of equal number of sources and mixtures, in which a N-channel sensor signal $\boldsymbol{x}(t)$ arises from N unknown scalar source signals $s_i(t)$, linearly mixed by an unknown $N\times N$ invertible matrix A:

$$\boldsymbol{x}(t) = \mathrm{A}\boldsymbol{s}(t). \tag{1}$$

We wish to estimate the mixing matrix A (or, alternatively, the *unmixing* matrix $\mathrm{W} = \mathrm{A}^{-1}$) and the source signal $\boldsymbol{s}(t)$. In the discrete-time case ($t = 1,...,T$) we can use matrix notation