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Asymptotic Performance Analysis of QML Multichannel Blind Deconvolution

Alexander Bronstein[1], Michael Bronstein[2], Michael Zibulevsky[1], and Yehoshua Y. Zeevi[1]

[1]Technion - Israel Institute of Technology, Department of Electrical Engineering, 32000 Haifa, Israel.
[2]Technion - Israel Institute of Technology, Department of Computer Science, 32000 Haifa, Israel.

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Abstract

We derive simple closed-form expressions for the asymptotic estimation error in multichannel quasi maximum likelihood (QML) blind deconvolution. The asymptotic performance bounds coincide with the Cramér-Rao bounds, when the true ML estimator is used. Special cases of single-channel blind deconvolution and instantaneous blind source separation are highlighted. Conditions for asymptotic stability of the QML estimator are derived.

Notation

A tensor notation is adopted in this work. Signals are represented as tensors and the Einstein summation convention is used, according to which repeated indices, one lower and one upper, are implicitly summed over:

$$a_i{}^j b_{jk} \quad = \quad \sum_j a_{ij} b_{jk}.$$

Multi-channel time signals are denoted as second-rank tensors, x_{it}, where i stands for the channel number and t is a discrete time index. Cross-talk kernels are expressed as third-rank tensors, $h_{ij\tau}$, denoting cross-talk from channel j to channel i at time τ.

Definition 1. *The discrete Fourier transform of $h_{ij\tau}$ is defined by*

$$\bar{h}_{ij}(\theta) \quad = \quad \mathcal{F}\left\{h_{ij\tau}\right\}(\theta) = h_{ij}{}^{\tau} e_{\tau}(\theta),$$