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Quasi Maximum Likelihood Blind Deconvolution of Images Using Optimal Sparse Representations

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Abstract

A quasi maximum likelihood framework for blind deconvolution of images is presented. We generalize the relative Newton algorithm, previously proposed for quasi maximum likelihood blind source separation and blind deconvolution of time signals, and provide asymptotic analysis of its performance. Smooth approximation of the absolute value is used to model the log probability density function, which is suitable for sparse sources. In addition, we propose a method of sparsification, which allows to perform blind deconvolution of sources with arbitrary distribution, and show how to find optimal sparsifying transformations by training.

1 Introduction

Two-dimensional *blind deconvolution* (BD) is a special case of a more general problem of *image restoration*. The goal of BD is to reconstruct the original scene from an observation degraded by a linear shift invariant (LSI) system, when no or very little *a priori* information about the scene and the degradation process is available, hence the term ”blind”. BD is critical in many fields, such as astronomy [4, 7, 8, 40], remote sensing [37], biological and medical imaging [1, 34, 35], microscopy [25, 28, 44], etc. Typically, the image degradation is a result of imperfections of an optical system, and can be presented in terms of convolution of the source image with some *blurring kernel* or *point spread function* (PSF); in such applications, the term *deblurring* is synonymous to deconvolution.