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Robust Bayesian Compressed Sensing with Outliers *

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Abstract

We consider the problem of robust compressed sensing where the objective is to recover a high-dimensional sparse signal from compressed measurements partially corrupted by outliers. A new sparse Bayesian learning method is developed for this purpose. The basic idea of the proposed method is to identify the outliers and exclude them from sparse signal recovery. To automatically identify the outliers, we employ a set of binary indicator variables to indicate which observations are outliers. These indicator variables are assigned a beta-Bernoulli hierarchical prior such that their values are confined to be binary. In addition, a Gaussian-inverse Gamma prior is imposed on the sparse signal to promote sparsity. Based on this hierarchical prior model, we develop a variational Bayesian method to estimate the indicator variables as well as the sparse signal. Simulation results show that the proposed method achieves a substantial performance improvement over existing robust compressed sensing techniques.

Keywords – Robust Bayesian compressed sensing, variational Bayesian inference, outlier detection.

1 Introduction

Compressed sensing, a new paradigm for data acquisition and reconstruction, has drawn much attention over the past few years [1–3]. The main purpose of compressed sensing is to recover a high-dimensional sparse signal from a low-dimensional linear measurement vector. In practice, measurements are inevitably contaminated by noise due to hardware imperfections, quantization errors, or transmission errors. Most existing studies (e.g. [4–6]) assume that measurements are

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