

Analysis of Mismatched Estimation Errors Using Gradients of Partition Functions*

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Abstract

We consider the problem of signal estimation (denoising) from a statistical-mechanical perspective, in continuation to a recent work on the analysis of mean-square error (MSE) estimation using a direct relationship between optimum estimation and certain partition functions. The paper consists of essentially two parts. In the first part, using the aforementioned relationship, we derive single-letter expressions of the mismatched MSE of a codeword (from a randomly selected code), corrupted by a Gaussian vector channel. In the second part, we provide several examples to demonstrate phase transitions in the behavior of the MSE. These examples enable us to understand more deeply and to gather intuition regarding the roles of the real and the mismatched probability measures in creating these phase transitions.

Index Terms

Minimum mean-square error (MMSE), mismatched MSE, partition function, statistical-mechanics, conditional mean estimation, phase transitions, threshold effect.

I. INTRODUCTION

The connections and the interplay between information theory, statistical physics and signal estimation have been known for several decades [1-4], and they are still being studied from a variety of aspects, see, for example [5-17] and many references therein.

*This research was partially supported by The Israeli Science Foundation (ISF), grant no. 412/12.