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Complex Independent Process Analysis*

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Abstract

We present a general framework for the search of hidden independent processes in the complex domain. The task is to estimate the hidden independent multidimensional complex-valued components observing only the mixture of the processes driven by them. In our model (i) the hidden independent processes can be multidimensional, they may be subject to (ii) moving averaging, or may evolve in an autoregressive manner, or (iii) they can be non-stationary. These assumptions are covered by integrated autoregressive moving average processes and thus our task is to solve their complex extensions. We show how to reduce the undercomplete version of complex integrated autoregressive moving average processes to real independent subspace analysis that we can solve. Simulations illustrate the working of the algorithm.

1 Introduction

Our task is to find multidimensional independent components for complex variables. This task joins complex-valued neural networks [6] with independent component analysis (ICA) [4]. Although (i) complex-valued neural networks have several successful applications and (ii) there is a natural tendency to apply complex-valued computations for the analysis of biomedical signals (see, e.g., [2] and [3] for the analysis of EEG and fMRI data, respectively) the methodology of searching complex-valued independent components is barely treated in the literature. There are existing methods for the simplest ICA and blind source deconvolution tasks, but — to the best of our knowledge — there has been no study on non-i.i.d multidimensional hidden variables for the complex case. We provide the tools for this important problem family.

The paper is structured as follows: We treat the simplest complex-valued independent subspace analysis (complex ISA) problem and its solution in Section 2. In

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