New Approaches for the Independent Component Analysis (ICA)

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Abstract. In the independent component (IC) model it is assumed that the components of the observed p-variate random vector $\boldsymbol{x}$ are linear combinations of the components of a p-vector $\boldsymbol{z}$ such that the p components of $\boldsymbol{z}$ are independent. Then $\boldsymbol{x} = \boldsymbol{\Omega z}$ where $\boldsymbol{\Omega}$ is a full-rank $p \times p$ mixing matrix. In the independent component analysis (ICA) the aim is to estimate an unmixing matrix $\boldsymbol{\Gamma}$ such that $\boldsymbol{\Gamma x}$ has independent components. The comparison of the performances of different unmixing matrix estimates $\hat{\boldsymbol{\Gamma}}$ in the simulations is then difficult as the estimates are for different population quantities $\boldsymbol{\Gamma}$. We present a new natural performance index which finds the shortest distance (using Frobenius norm) between the identity matrix and the set of matrices equivalent to the gain matrix $\hat{\boldsymbol{\Gamma}}\boldsymbol{\Omega}$. The index is shown to possess several nice properties, and it is easy and fast to compute. Also, the limiting behavior of the index as the sample size approaches infinity can be easily derived if the limiting behavior of the estimate $\hat{\boldsymbol{\Gamma}}$ is known.

References

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