International Journal of Innovative Computing, Information and Control
Volume **7**, Number **2**, February **2011**
 ISSN 1349-4198
pp. 989–1000

DIMENSIONAL REDUCTION USING BLIND SOURCE SEPARATION FOR IDENTIFYING SOURCES

Ganesh R Naik and Dinesh K Kumar
School of Electrical and Computer Engineering
RMIT University
GPO BOX, 2476V, Melbourne, Australia
ganesh.naik@rmit.edu.au

Received October 2009, Revised February 2010

Abstract. *Separation of independent sources using Blind Source Separation (BSS) techniques requires prior knowledge of the number of independent sources. Performing BSS when the number of recordings is greater than the number of sources can give erroneous results. Techniques employed to estimate suitable recordings from all the recordings require estimation of number of sources or require repeated iterations. This paper demonstrates that normalised determinant of the global matrix is a measure of the number of independent sources, K, in a mixture of M recordings. This paper also shows that performing ICA on K out of M randomly selected recordings gives good quality of separation. The qualities of the outcome of this experiment were measured using Signal to Interference Ratio (SIR) and Signal to Noise Ratio (SNR). The results demonstrate that using this technique, there is an improvement in the quality of separation as measured using SIR and SNRs.*
Keywords: Blind source separation (BSS), Independent component analysis (ICA), Global matrix, Frobenius norm, Source separation, Source identification, Undercomplete ICA, Overcomplete ICA

1. Introduction.

Blind Source Separation (BSS) consists of estimating the original signals s, of different sources from a finite set of observations $x(t)$, which is a result of mixing the original signals $s(t)$. The estimation is independent of the propagation medium and without any prior knowledge of the sources. BSS has found number of applications in medicine [1, 2], communications [3, 4], audio signals [5, 6] and image processing [7, 8, 9]. Independent component analysis (ICA) [10, 11] has become a widely accepted technique to solve the BSS problem. It is based on the assumption that the sources are independent and immobile.

BSS consists of two major issues: source number estimation and source separation. For conceptual and computational simplicity, most ICA algorithms assume that the number of sources is equal to the number of recordings and this result in the mixing matrix to be a square matrix. This simplifies estimation of the mixing matrix A and un-mixing matrix W, because square matrix can be inverted. However, this equality assumption in general is not accurate for number of applications. If the number of sources exceeds the number of sensors (recordings) then the situation is referred to as 'over-complete' while when the number of sources is less than the number of recordings, it is referred to as 'under-complete'.

Researchers have studied the over-complete situation extensively. In over-complete situation, application of standard ICA can result in incorrect separation as demonstrated by Lewicki and Sejnowski [12]. Bofill and Zibulevsky [13] have attempted to identify the number of sources in a mixture for over-complete situation. While under-complete