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AN ADAPTIVE APPROACH FOR ICA BASED BLIND SOURCE SEPARATION FOR MULTI-SENSORY SYSTEMS

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In this paper, an algorithm to separate unknown sources from an over determined set of noisy mixtures was introduced by utilizing an adaptive independent component analysis (ICA) algorithm. Most source signals in a noisy mixture have overlapping bandwidths making it impossible to use standard filtering techniques to separate the sources. Due to the fact that ICA utilizes higher order statistics such as mutual independence, kurtosis, negentropy etc., it has the capacity to extract sources with overlapping spectral content.

This blind source separation (BSS) technique that we propose can be applied to a wide array of applications including, but not limited to, acoustics, communication, context aware networks, computer vision, defence and security systems and bio-medicine. In such systems, the significance of utilizing BSS methods is that, such techniques do not rely on information related to the source signals which are to be extracted.

We have analyzed a brute force approach for source separation through the identification of local maxima points for mixtures that comprise super Gaussian source signals. Due to its limitations in higher dimensions, a gradient based adaptive approach was proposed. The adaptation process attempts to converge to a local maximum (in the super Gaussian case) through a gradient ascent approach.

We conducted a detailed analysis of the kurtosis based gradient ascent ICA algorithm in the weight vector normalized subspace. Here we studied the behavior of the adaptation path and the variation of the direction of the kurtosis gradient. This enabled us to understand the behavior of the kurtosis surface gradient in the reduced space and realize its limitations as a convergence criterion. Thus, it was proposed to utilize kurtosis difference as the convergence criteria for the adaptation process. The proposed method is extendable for sub Gaussian and super-sub Gaussian mixtures.

The results of the proposed analysis verify the proposed method's ability to extract source signals from a set of over determined mixtures without knowing any details about the sources concerned. The resultant extracted signals clearly matched the original source signal waveforms. Furthermore, the reasoning for utilizing kurtosis difference as the convergence criterion rather than the surface gradient value which does not converge to zero was demonstrated through a detailed analysis. We are exploring mechanisms to improve the convergence behaviour of the proposed method.