

Blind Source Separation

Abstract: Blind source separation (BSS) and independent component analysis (ICA) are by and large based on a wide class of unsupervised learning algorithms and they have potential applications in many areas from applied sciences like neuroscience to engineering. The BSS exploits the priori knowledge of nature and structure of hidden sources such as sparseness, noise, gaussianity, spatio-temporal decorrelation, statistical independence. Independent component analysis (ICA) and blind source separation (BSS) refer to the problem of recovering statistically independent signals from a linear mixture. Herewith, a review of BSS and ICA has been presented with respect to the number of methods, research procedures, models developed, technological up gradation being practiced, so that the pathways of research in the field can be obtained. The paper is divided into four sections such as, a) Introduction b) Approaches & methods c) Recent developments and d) Applications.

1. Introduction Blind source separation was first considered in 1982 from a simple discussion between Bernard Ans, Jeanny Héault and Christian Jutten with Jean-Pierre Roll, a neuroscientist, about motion decoding in vertebrates. Joint motion takes place because of muscle contraction; each muscle fiber is controlled by the brain, through a moto-neuron. In addition, on each fiber, the muscle contraction is measured, and the information of the same is transmitted to the central nervous system by two varieties of sensorial endings, located in tendon, and is called primary and secondary endings. For trustworthiness reasons, results are obtained by averaging unit sensory responses coming from a huge number of fibers, related to the repetition of the same forced motion. Surprisingly, while one could imagine that each type of ending only transmits one type of information, either stretching or speed, the sensory information transmitted by endings is a mixture of stretching and speed information [Simon Haykin, (1999) and Jutten C. (1987)]. In blind source separation (BSS), multiple observations are carried out by an array of sensors are processed in order to recuperate the initial mixing of the source signals. The term blind refers to the fact that there is no specific information about the mixing process or about the existing source signals.

The perception of blind source separation is related to independent component analysis (ICA). However, ICA can be viewed as a general-purpose tool replacing principal component analysis (PCA) which means it is applicable to a wide range of problems. Some application domains of blind source separation are biomedical signal analysis, geophysical data processing, data mining, wireless communications and sensor array processing [Karhunen J. (1999)].

1.1. The BSS model : Blind source separation (BSS) is a major area of research in signal and image processing. It aims at recuperating source signals from their mixtures without meticulous knowledge of the mixing process. The job is to calculate approximately the individual source without signals, i.e. to demix the mixture. The Blind Source Separation (BSS) problem is defined by a mixture model (see figure 2), a set of source processes, and a set of assumptions.