**Independent Component Analysis and Blind Source Separation and it’s Application in Image Denoising**

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**Overview and Motivation:**    
The Blind Source Separation (or cocktail party) problem is a very interesting and very basic problem; yet there hasn’t been as easy a solution to this problem as it’s formulation until the development of the Independent Component Analysis technique. Image Denoising proves to be a very effective application of this technique. Hence, we have chosen this topic.

Upon initial investigations, we have found that the Independent Components are similar to Principle Components, but embed in them higher order statistical information (example, kurtosis) of the data as compared to Principle Components obtained using Singular Value Decomposition which mainly encode information about the variance of the data in them. As a result, this technique provides basis of classification and separation that is more detailed than using just variance as a measure of diversity in a given data set.

**Core Concepts:**

The main concept used in this project is the Independent Component Analysis technique which builds upon the Singular Value Decomposition and Principle Component Analysis that we have learnt so far in the course.

The essence of Independent Component Analysis and the Blind Source Separation problem is as follows:  
  
We assume a data vector ***X*** (say an audio signal of someone speaking in a room with some other stray noise like our ears pick up one person’s noise amongst many others at a cocktail party) as being a linear combination of **statistically independent** sources of sound. That is:

Where is a matrix whose columns are the **statistically independent** sources of sound and are the weights of these sources of sound. Independent component analysis is the technique of finding ***U*** and ***w*** mentioned above using training data sets.

We will use Natural images with noise in them as our training and testing data sets and posit that at least one independent component obtained represents the noise signal. We can then project each of the images onto the subspace that contains all of the Independent components except the ones that represent the noise.

**Related Papers and Resources:**

<http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.30.5264&rep=rep1&type=pdf>

<http://www.mit.edu/~gari/teaching/6.222j/ICASVDnotes.pdf>

<http://www.stat.ucla.edu/~yuille/courses/Stat161-261-Spring14/HyvO00-icatut.pdf>