SEPARATING MIXED IMAGES USING FASTICA

CMSC 191 - MACHINE LEARNING

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March 18, 2019

ABSTRACT

1 Introduction

1.1 Noise Reduction

Noise Reduction, or denoising, is defined as the attempt the noise present in the signal. Noise refers to any kind of random disturbance of the signal [1]. The noise reduction is a technique applied to sound and visual media where clarity is of importance. One of the techniques to implement noise reduction is known as the Independent Component Analysis (ICA) which will be discussed later on. Using the said technique, the original form of sound or image can be retrieved albeit with in a different scale.

1.2 Independent Component Analysis (ICA)

Suppose in a noisy room, there are two microphones placed such that one person's voice is recorded. The microphones record both voices along with the noise in the background. The problem now is to distinguish the two voices in the recording while eliminating the noise. This is what is known as the *cock-tail-party problem* [2].

The Independent Component Analysis (ICA) is a statistical and computational technique for revealing hidden factors in that underlie sets of random variables, measurements, or signals [3]. This technique was originally developed to tackle with the *cocktail-party problem* and cases similar to it such as removing noise from images and analyzing electroencephalograms (EEGs). It has also been used in feature extraction to find suitable representations for images and sounds [4].

One thing to note about the ICA is that the data to be processed must be non-Gaussian, that is, the data points are independent from each other [5]. It must also be noted that the technique is unable to properly determine the scales(variances) of the individual components [4].

2 The Dataset

The images used for this study are the artworks of Meloetta, both Aria Forme and Piroutte Forme, by Ken Sugimori. The images used can be seen below at figure 1.

(a) Aria Forme

(b) Piroutte Forme

Figure 1: Meloetta Formes

These images are then blended with each other using the Python Image Library (PIL) with `alpha = [0.25, 0.75]`.

(a) `alpha = 0.25`

(b) `alpha = 0.75`

Figure 2: Blended Images

3 ICA Decomposition

To deconstruct the mixed images, `scikit-learn`'s FastICA, an implementation of the ICA, will be used [6]. `numpy` will also be used in this deconstruction.

The two images will be flattened first. The resulting arrays will then be passed on to `FastICA()` with `n_components=2`. The results are to be reshaped to reform the estimates of the images.

4 Results

The results of the experiment are the following:

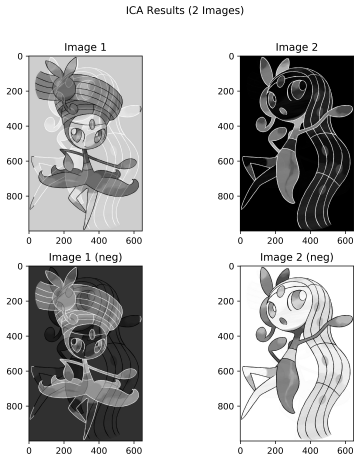

Figure 3: Estimates of the original images

The experiment yielded two images corresponding to the two figures used to create the image. The negative versions of the estimates are also used in the case where the estimate has a negative scale.

5 Conclusion

From figure 3, it can be seen that the decomposition was successful to the point where the estimates retrieved are very close to figures 1a and 1b albeit with the lack of colour and inverse scales. The lack of colour is attributed to the use of `cmap='gray'` used in presenting the figures. The inverse of the colours is due to the inability of the ICA to obtain the original scales of the images.

References

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