Homework 2: Independent Component Analysis

Name: Shun Zhang
Email address: jensen.zhang@utexas.edu
EID: sz4554

1 Independent Component Analysis

In this report, I applied Independent Component Analysis on Blind Source Separation problem.

2 Experiment

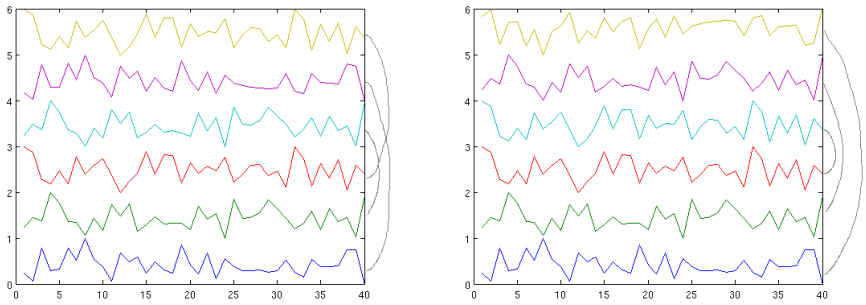

Figure 1: The bottom 3 lines are original signals from `icaTest.mat`. The top 3 lines are reconstructed signals with $\eta = 0.01$ and 1000000 iterations. Two independent experiments are shown.

The results are scaled into $[0, 1]$ interval. This experiment is repeated twice. The results are in shown in Figure 1. The result can be permutation of the

	Recon. 1	Recon. 2	Recon. 3
Source 1	-0.4900	0.9905	-0.4248
Source 2	0.9918	-0.3957	-0.5454
Source 3	-0.4829	-0.5073	0.9924

Table 1: Linear correlation between source and reconstructed signals, for the left figure in Figure 1.

	Recon. 1	Recon. 2	Recon. 3
Source 1	-0.4248	-0.5454	0.9924
Source 2	-0.4900	0.9918	-0.4829
Source 3	-0.9905	0.3957	0.5073

Table 2: Linear correlation between source and reconstructed signals, for the right figure in Figure 1.

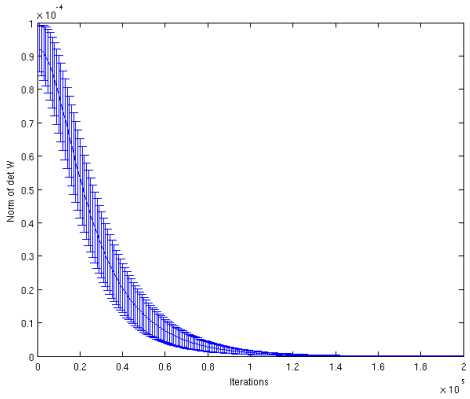

Figure 2: ΔW over number of iterations. Average of 5 runs. The length of vertical bars is σ assmuing Gaussian distribution of data points at each iteration.

original sources. Scaling is also possible (as the results are scaled into $[0, 1]$, the signal could be flipped in this case). The correlation between source and reconstructed signals are shown in Table 1. They are highly correlated if the correlavance is clost to 1 or -1. We can tell in the left figure, the mapping is 0-4, 1-5, 2-3. While in the right one, the mapping is 0-5, 1-3, 2-4. This result can be verified visually.

We can observe that the constructed signal is flipped for the third source in the right figure. It is negatively correlated with its reconstructed signal. Also, the algorithm overall generate highly close signal, with has more than 0.99 correlavance with its source signal.

I also examine how progress is made in each iteration in the learning process. As the algorithm uses gradient descent, the update on W each step, which is ΔW, is useful. For the convenience of visualization, I need the magtitude of this matrix. I use the largest singular value here, which can be got by `norm` function when applied to a matrix.

The result is shown in Figure 2.

Result on sound.

3 Discussion

4 Conclusion