

Machine Intelligence 2

Exercise sheet 7

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Exercise 1 - Kurtosis of Toy Data

In this exercise we can have a feeling about the meaning of kurtosis. Rotating randomly distributed data (after sphering) we can achieve different values of kurtosis for different dimensions. Since we de-correlate the data, samples are distributed along orthogonal directions; this results in a phase shift of π when the kurtosis is estimated for the two dimensions as a function of the rotation angle. From these plots we can see that the kurtosis is a measure of how “peaky” is a distribution compared to a gaussian. This is particularly clear in the example with the uniform distribution.

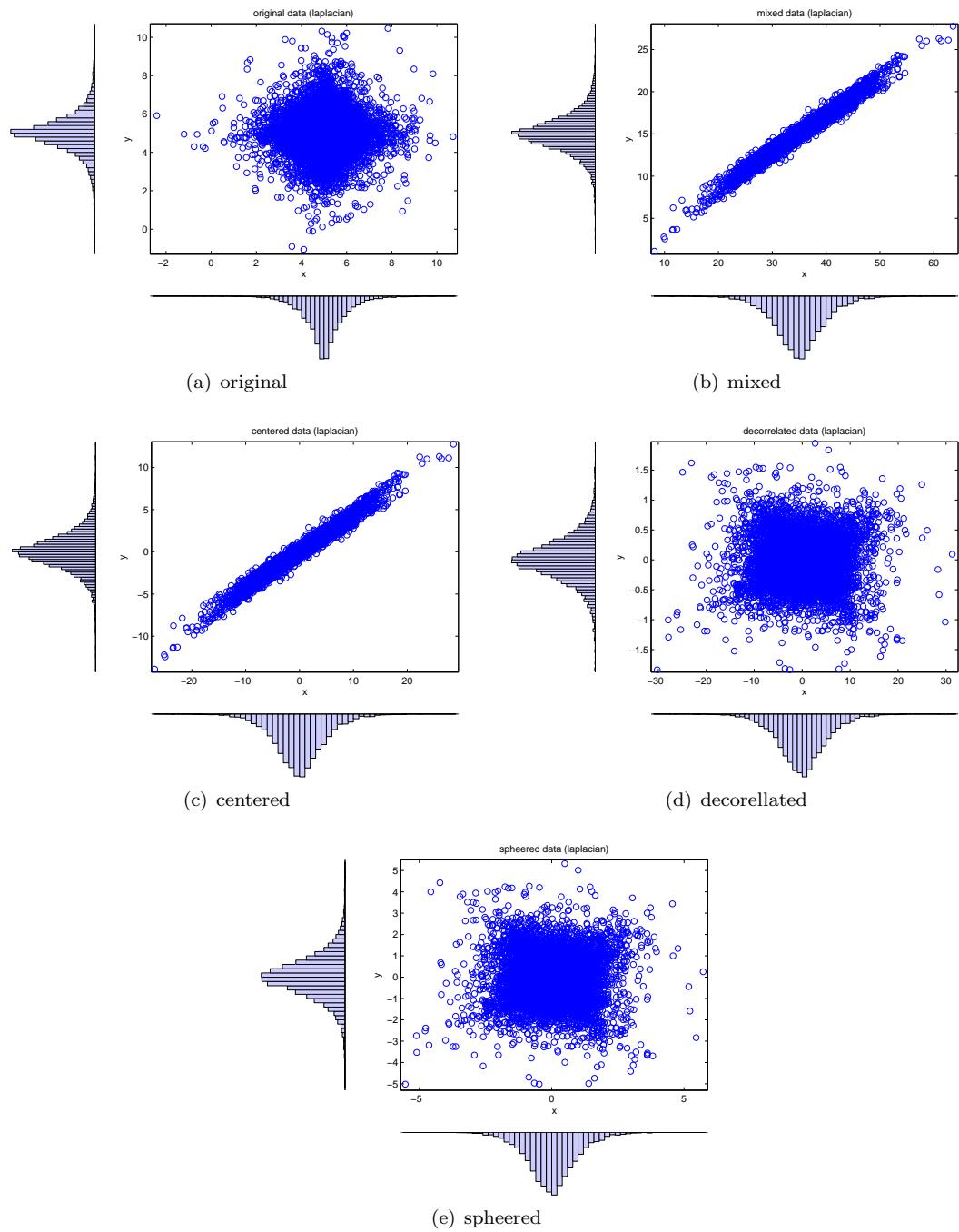
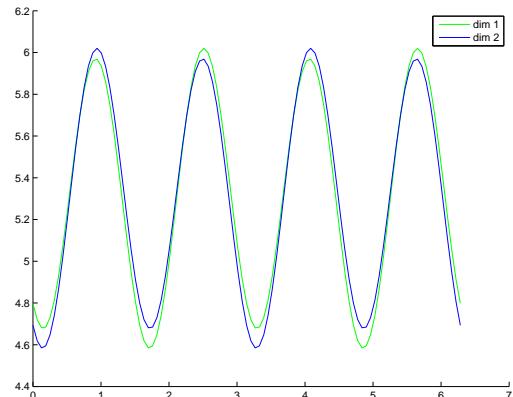
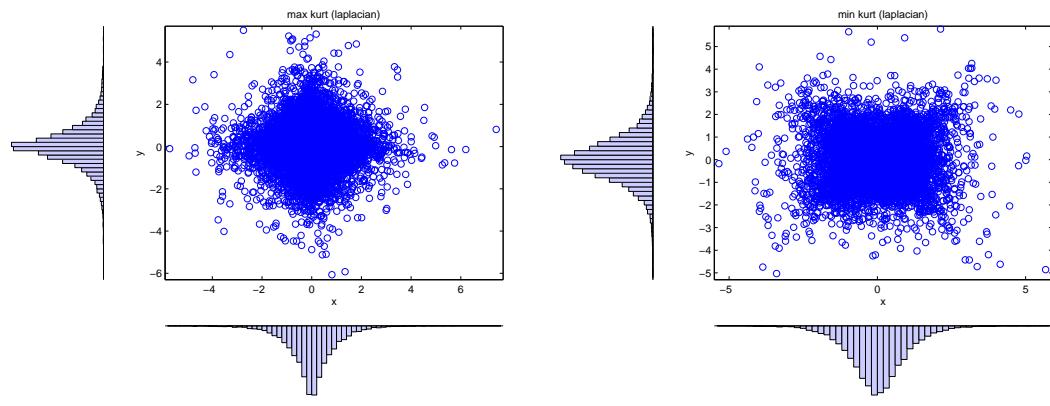


Figure 1: Spheering laplacian distribution



(a) kurtosis



(b) maximum kurtosis

(c) minimum kurtosis

Figure 2: Rotating laplacian distribution to find maximum and minimum kurtosis

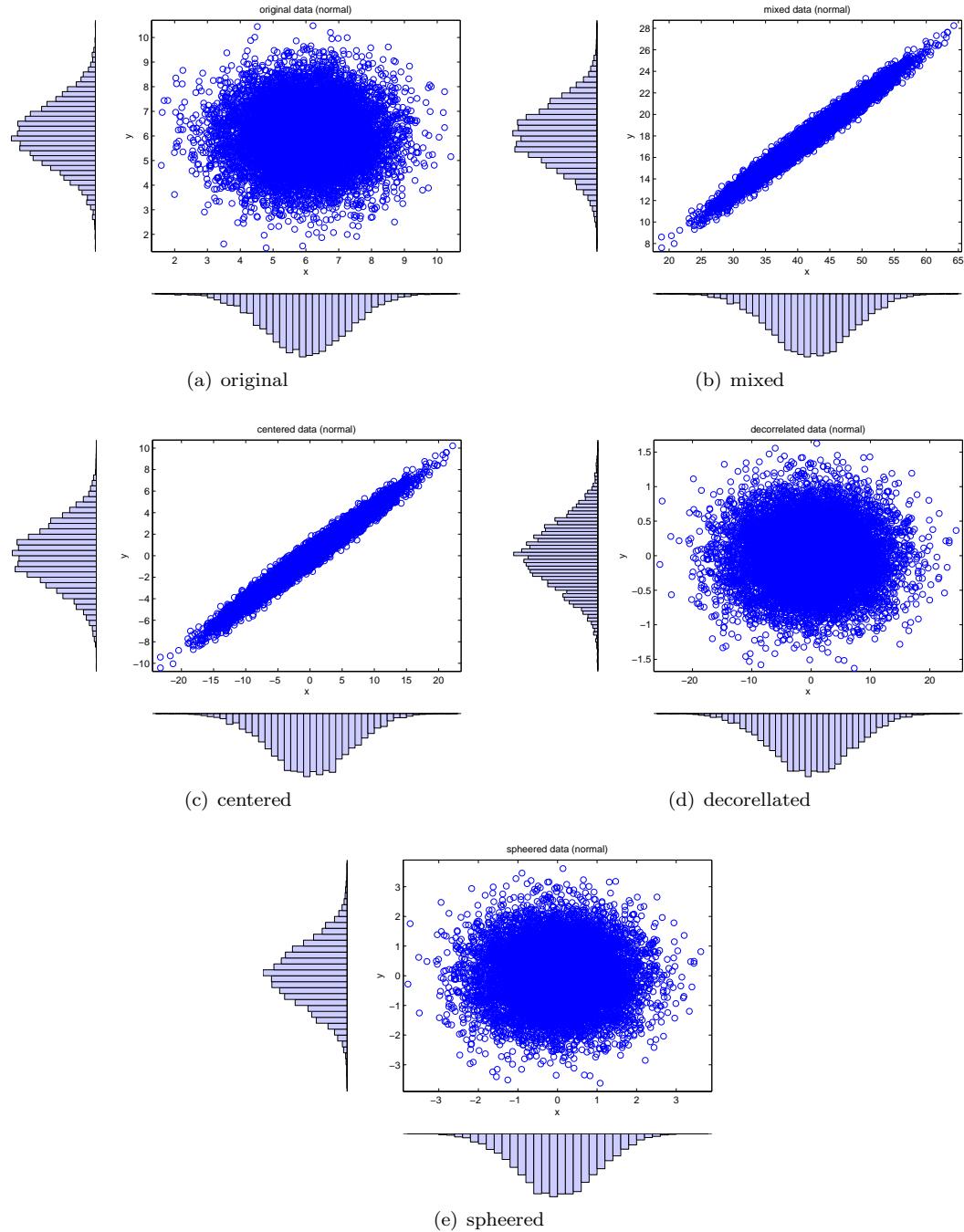
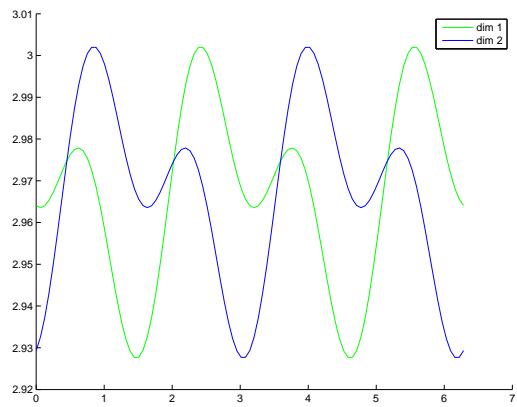


Figure 3: Spheering normal distribution



(a) kurtosis

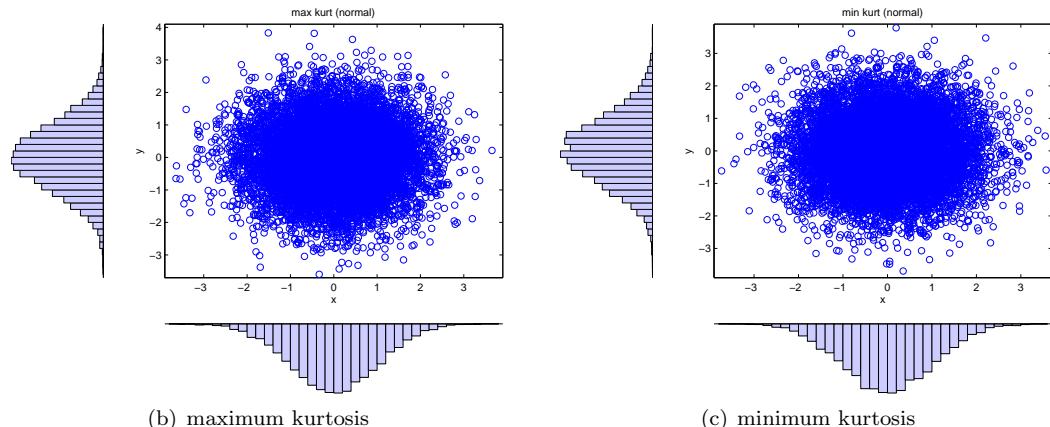


Figure 4: Rotating normal distribution to find maximum and minimum kurtosis

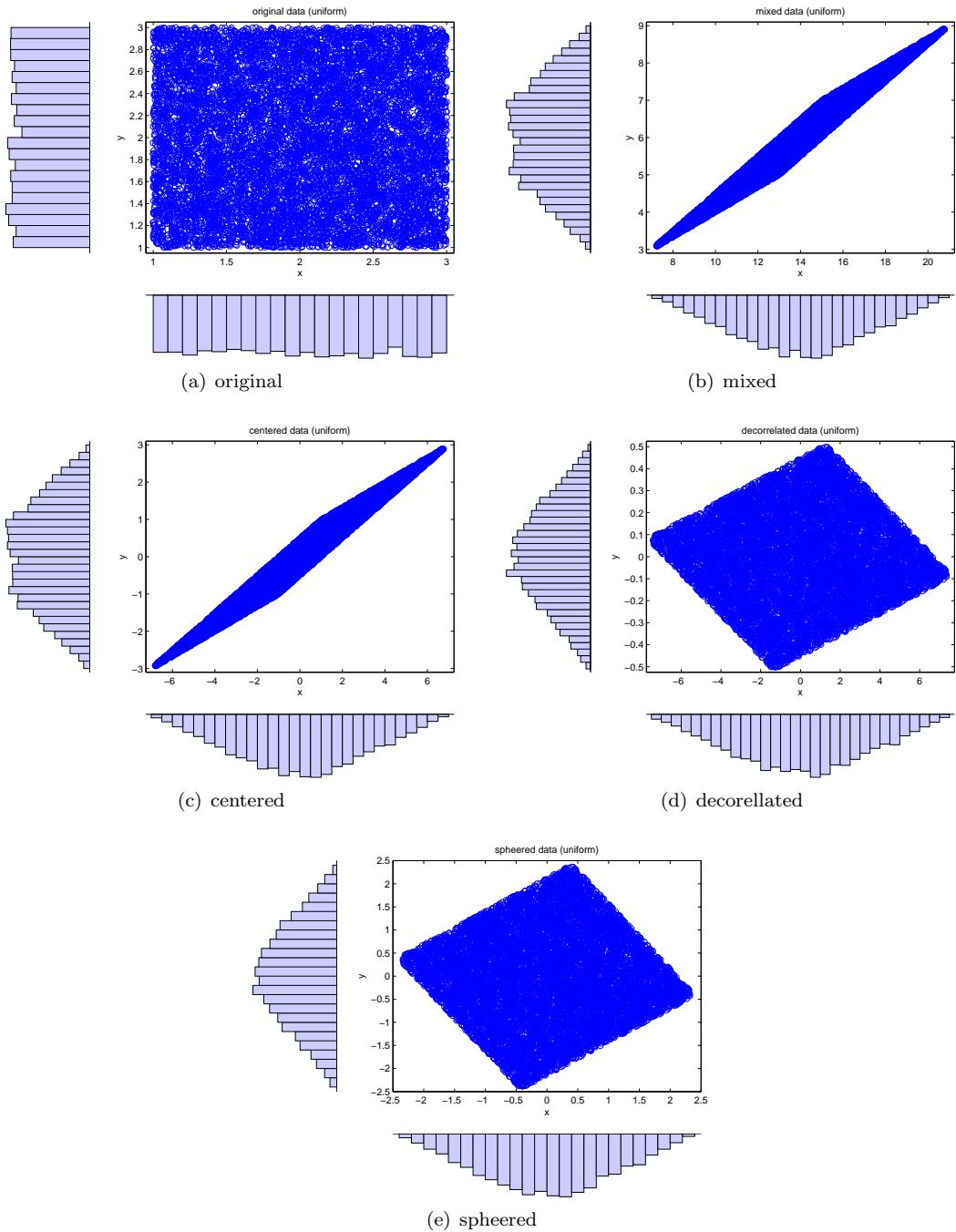
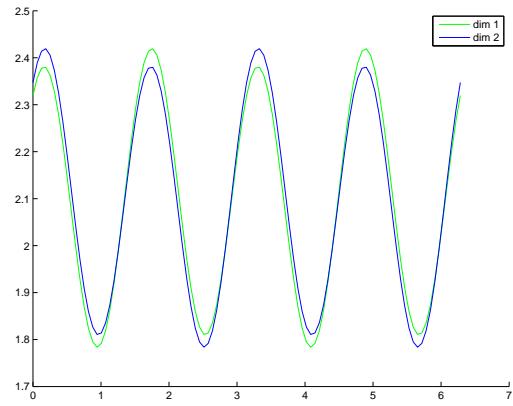


Figure 5: Spheering uniform distribution



(a) kurtosis

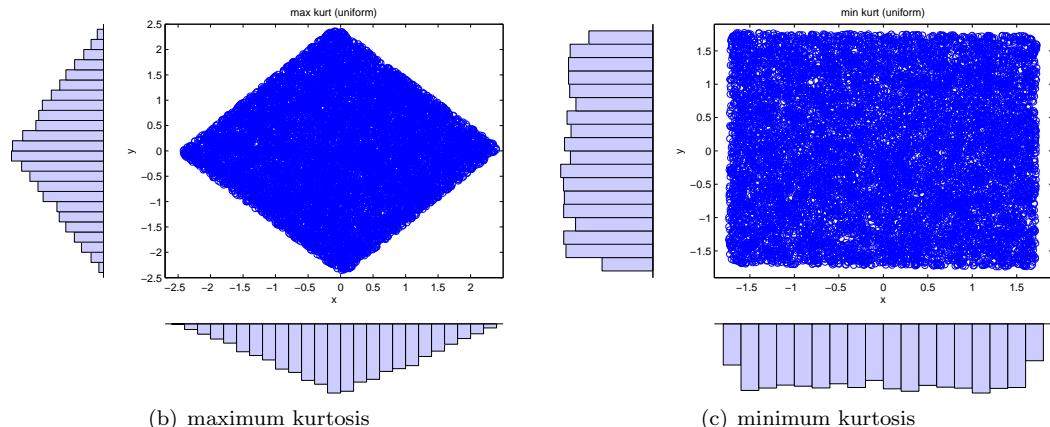


Figure 6: Rotating uniform distribution to find maximum and minimum kurtosis

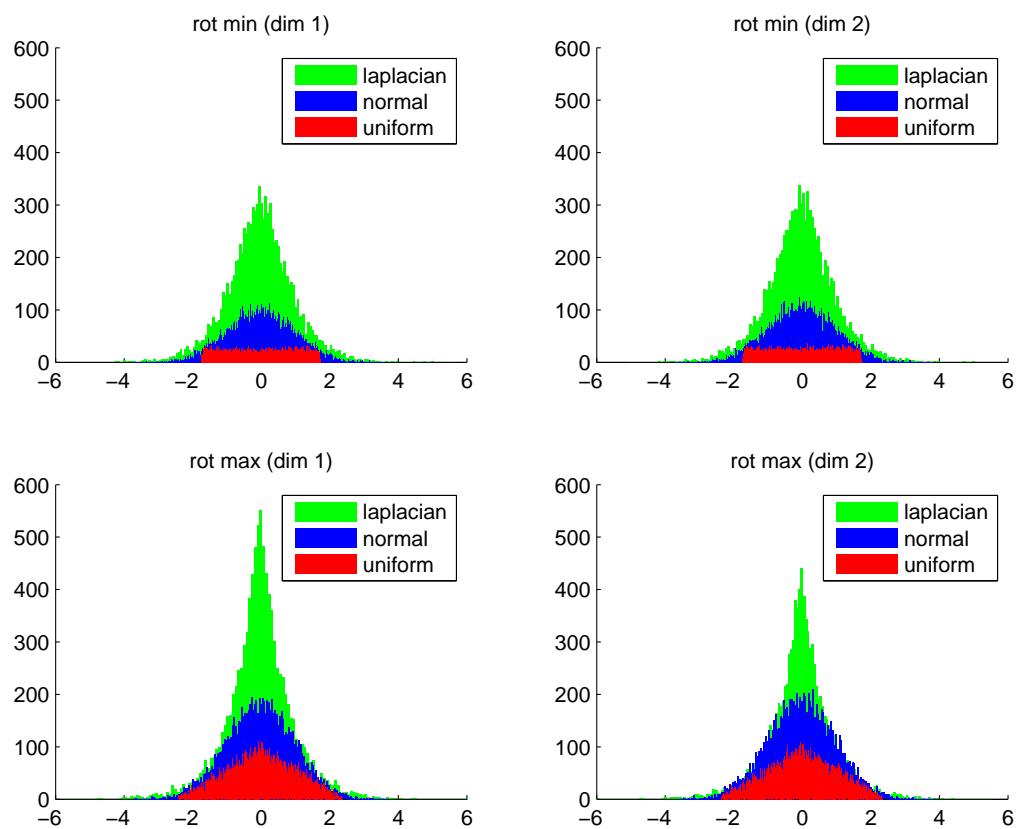


Figure 7: Histogram comparison for maximum and minimum kurtosis

Exercise 2 - Toy Signal Separation

In this exercise we mix three independent signals and we recover the original sources using the ICA algorithm. All the sources have been recovered successfully, we also observe that sources can be recovered in different scales and different orders with respect to the original signals.

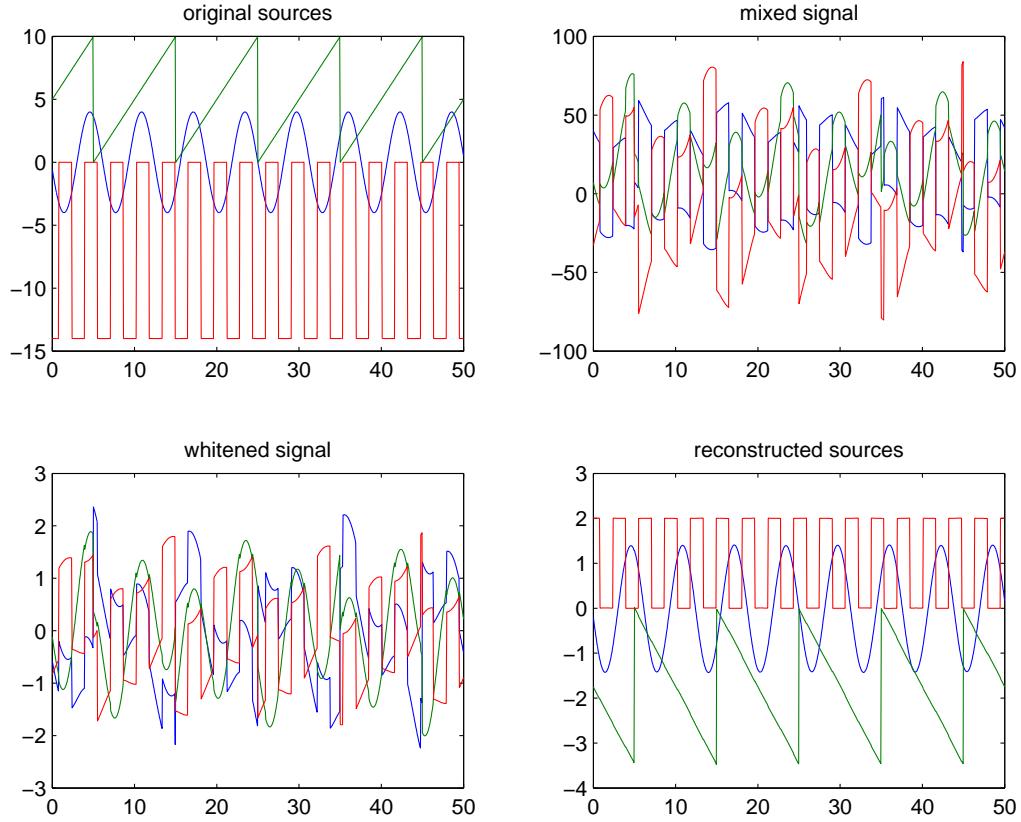


Figure 8: Toy signal separation

Exercise 3 - ICA on Image Patches

In this exercise we apply ICA to image patches of different categories: nature, building and text. We plot the columns of the mixing matrix A estimated using the ICA algorithm. These represent distinctive independent features for each image category (only the first 20 independent features are shown). We can see that with natural images the independent features are gabor-like functions and resemble the natural basis of the Fourier domain. As expected, for images of buildings we observe more edgy features while for the text category we obtain both edgy and gabor-like independent features.

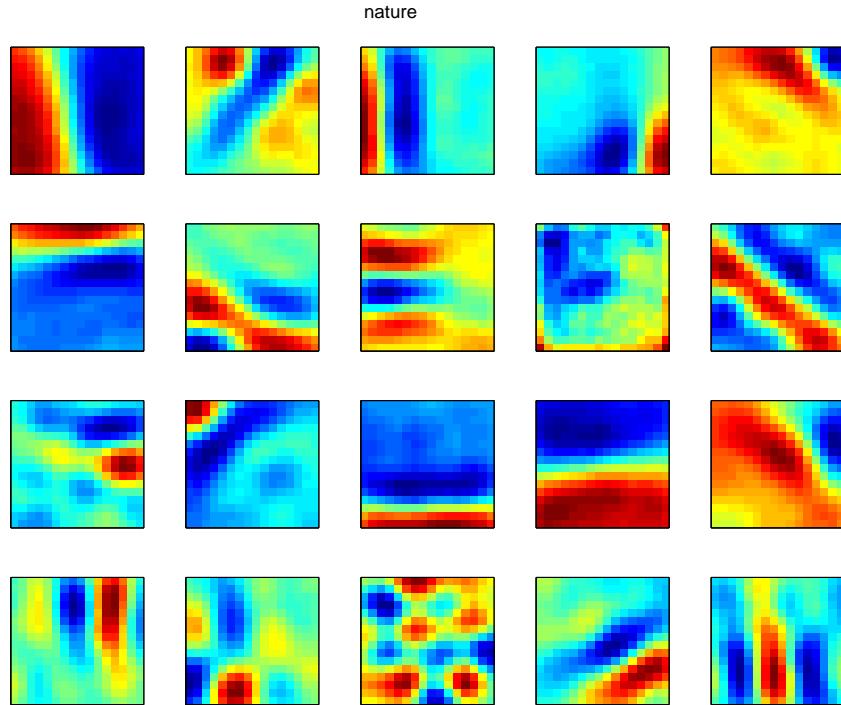


Figure 9: First 20 independent features extracted from *nature* image patches

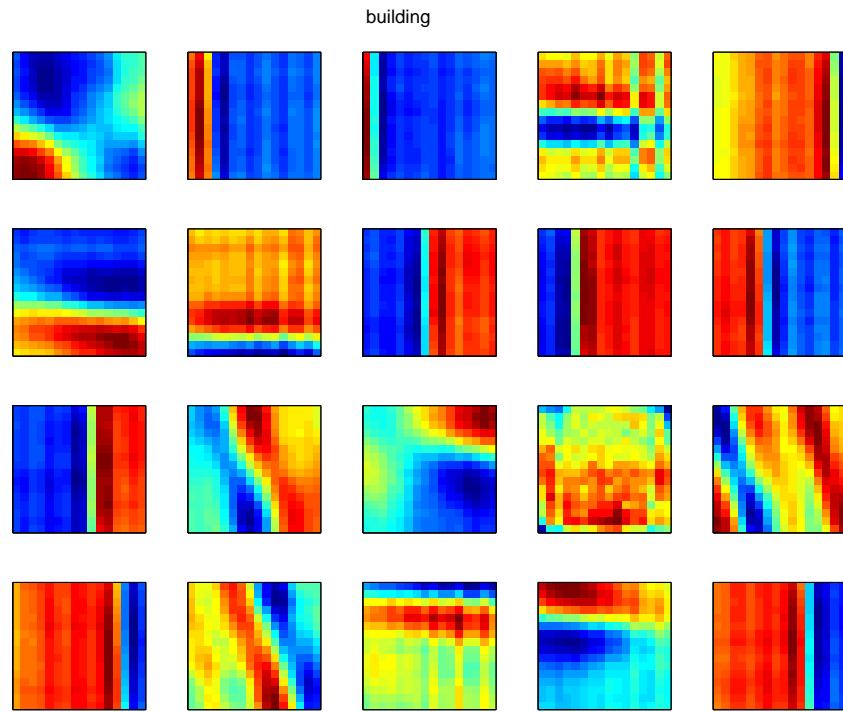


Figure 10: First 20 independent features extracted from *building* image patches

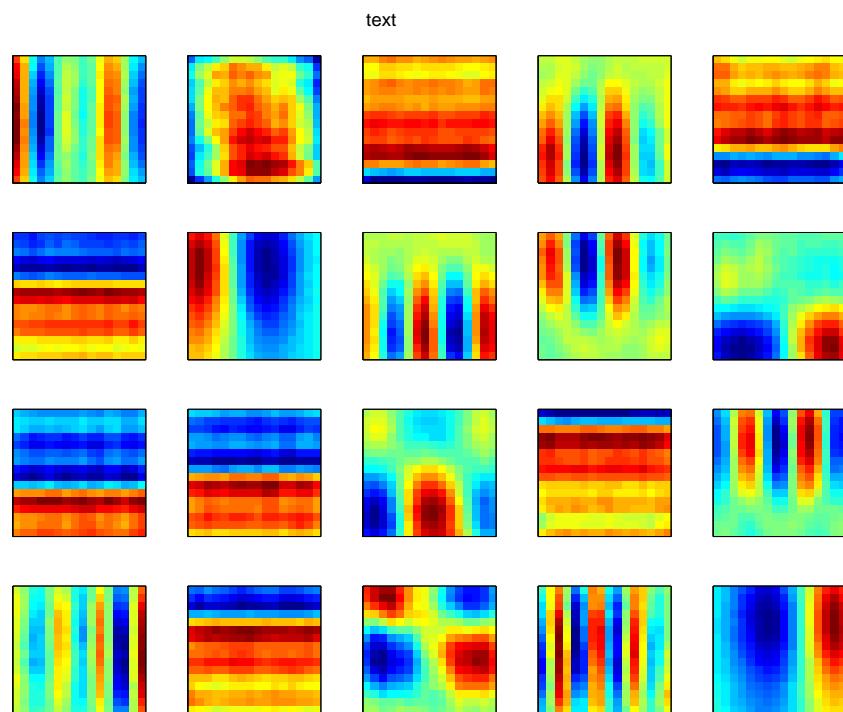


Figure 11: First 20 independent features extracted from *text* image patches