Advanced neuroscience

Assignment 9

Sajad Ahmadi Nabi

Sajjadahmadi7627@gmail.com

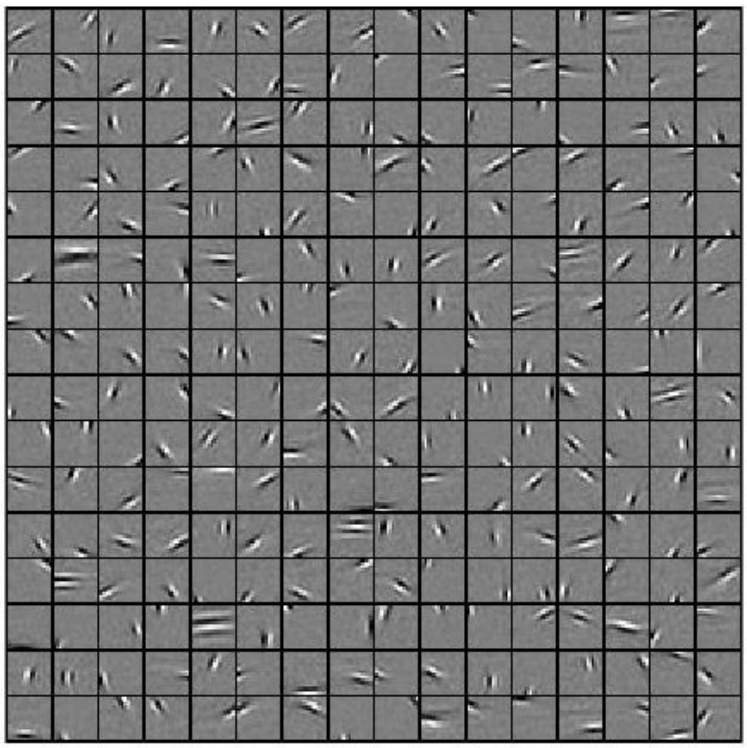
ID: 400206584

STEP1: Simulate sparse basis functions of the natural images: here we have database name IMAGES.mat which contains 10 natural images. I used whitened.m function to whiten images. Images should be square and are showed here.

Orginal Imges

whitened Images

Here are the sparse representation for natural images. 64*64 (256 basis functions) made by 10000 trials from original images. Gabors can be distinguished clearly here.



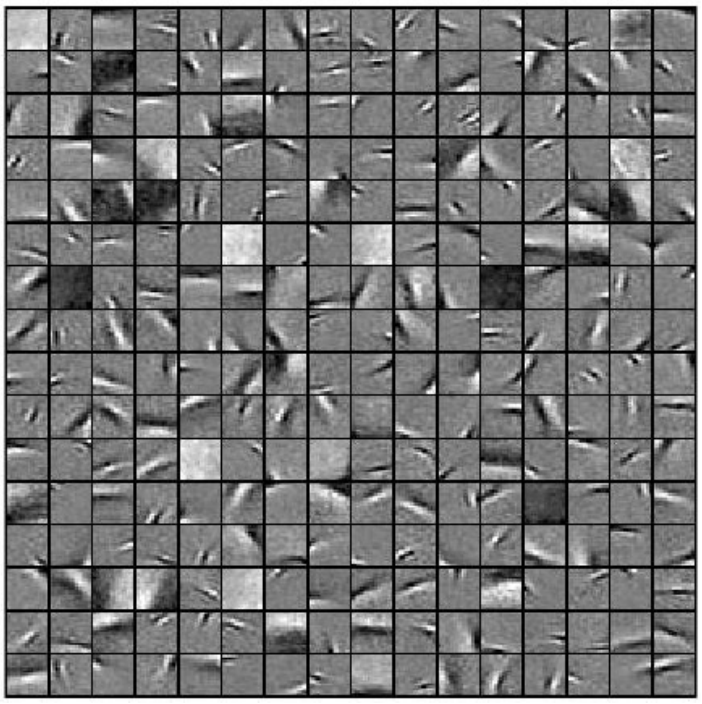
256 basis functions for original natural images

Step2: Study the effect of different datasets.

Yale database:

Here is the Yale dataset which contains just faces.

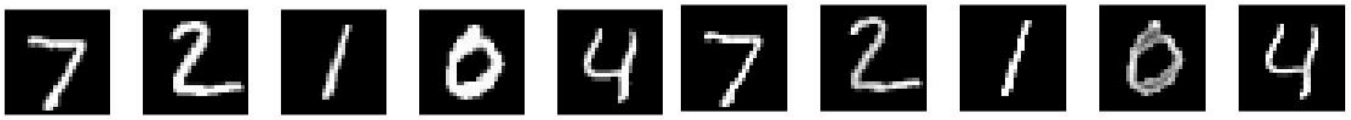
here are the sparse representation of 256 basis functions for Yale dataset which Gabors can be distinguished but not clearly as previous part.



256 basis functions for Yale images

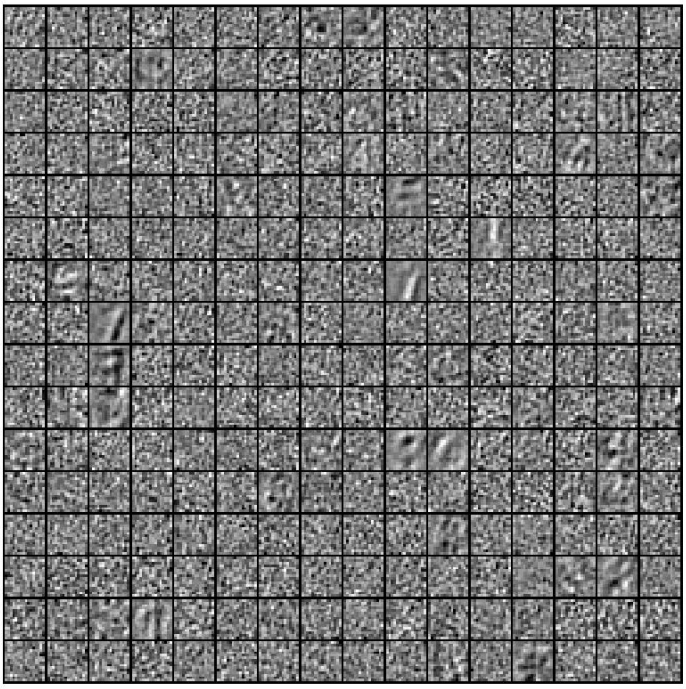
Mnist database:

mnist



mnist whitened

Mnist dataset contains handwritten numbers and digits. We can not find clear gabors in basis functions.



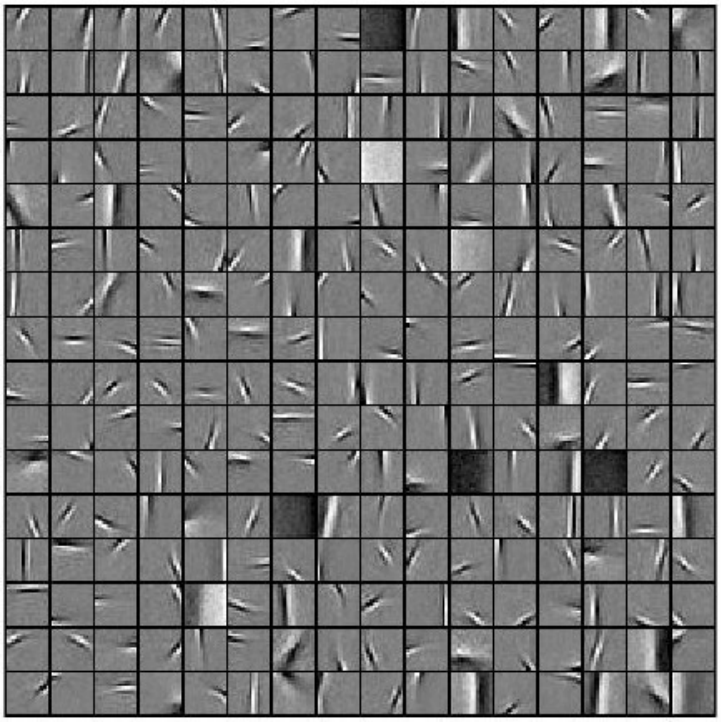
256 basis functions for Mnist images

Caltech 101:

Caltech101 contain many different images but here I just used human faces like Yale dataset, we can see sparse representation is similar to Yale one. It can be obtained that human faces doesn't make clear gabors in this function.

Caltech 101

Caltech 101 whitened



256 basis functions for Caltech 101 images

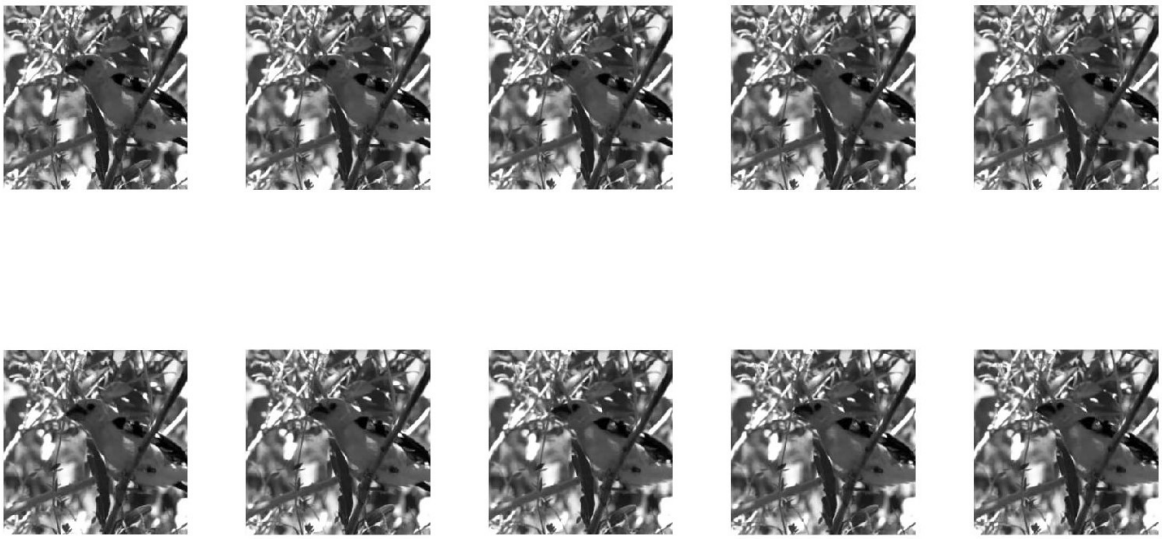
Step3: Coefficients in Time (Bird Video)

In this part, 10 frames, contain 10 images, are classified. Each frame has been whitened and Coefficients are calculated for each frame. Here one of ten frames is randomly showed.

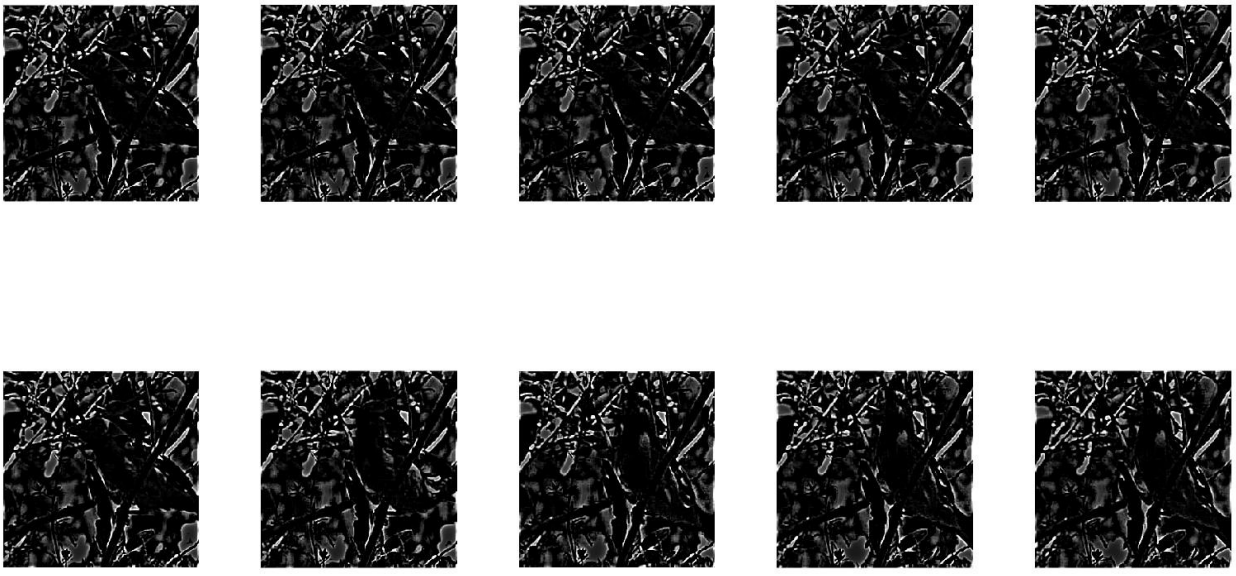
64 basis function is learned for each frame and coefficient for each frame and 64 patches (cause each image went into 8*8 patches) is calculated.

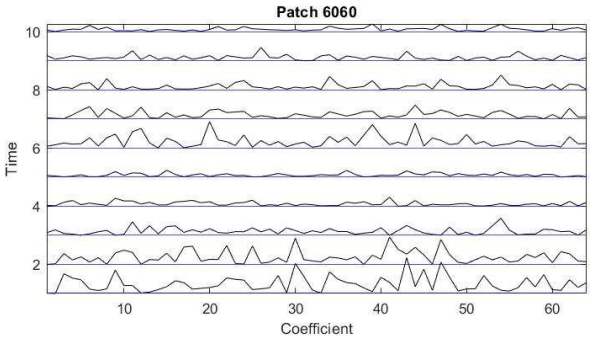
Some frames are plotted randomly.

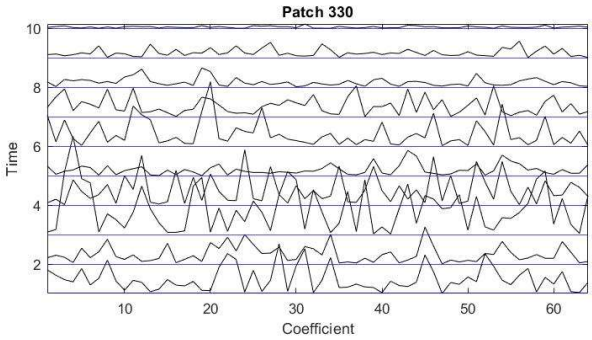
frame 4 org

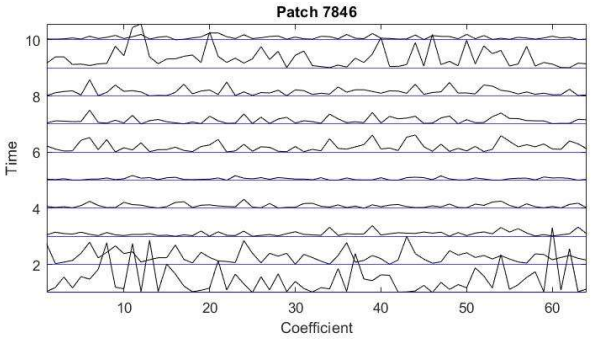


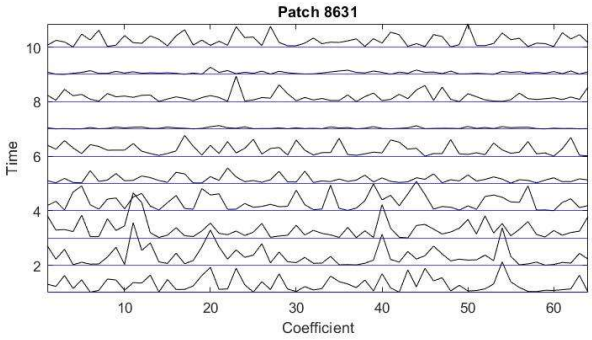
frame 4 whitened

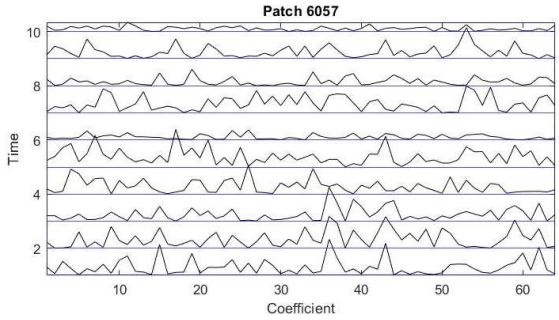


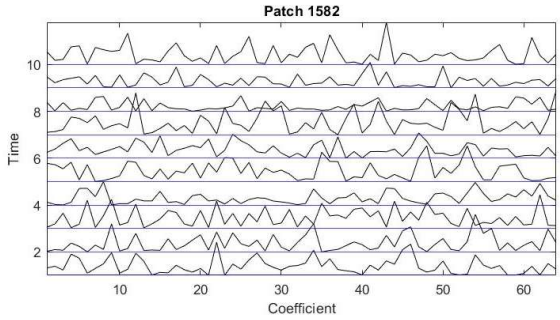

Patch 6060
Time
Coefficient

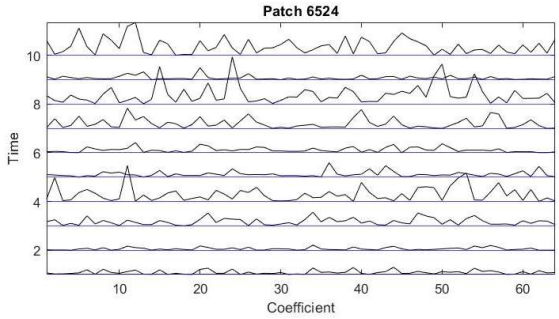

Patch 330
Time
Coefficient

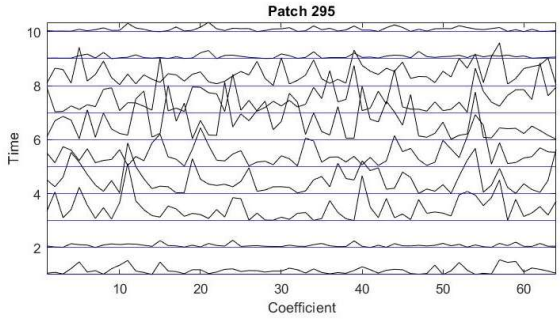

Patch 7846
Time
Coefficient


Patch 8631
Time
Coefficient

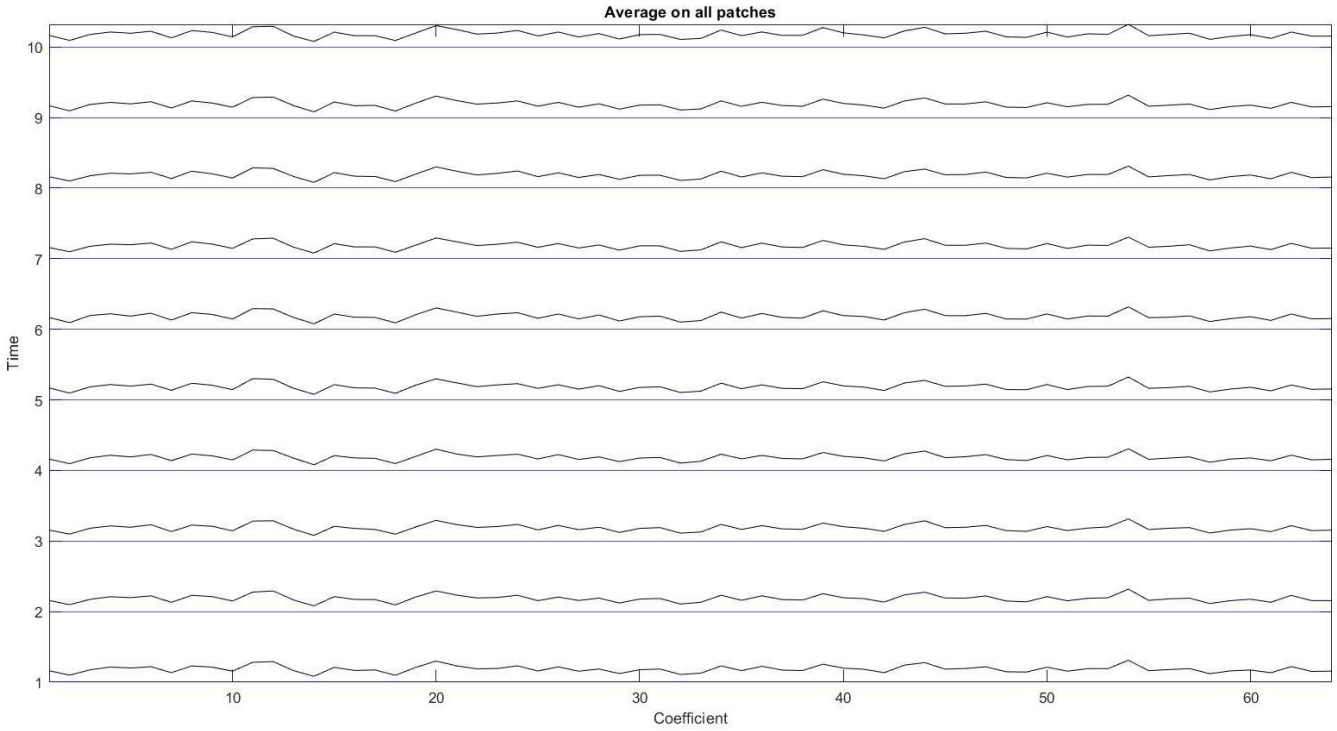

Patch 6057
Time
Coefficient


Patch 1582
Time
Coefficient


Patch 6524
Time
Coefficient


Patch 295
Time
Coefficient

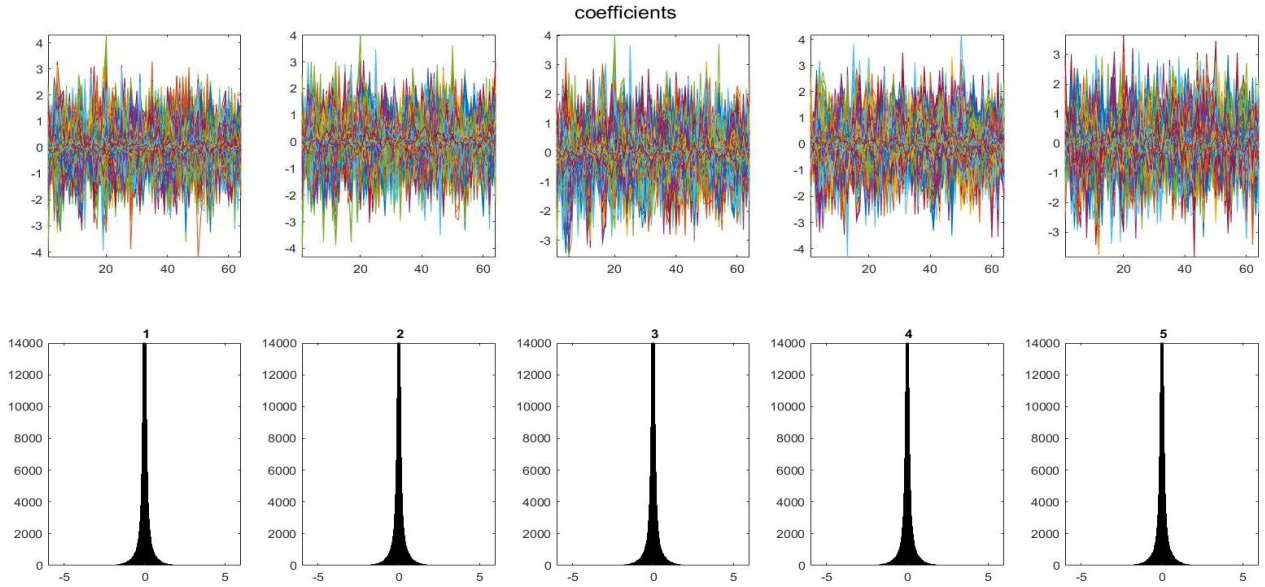
And here average over all patches.

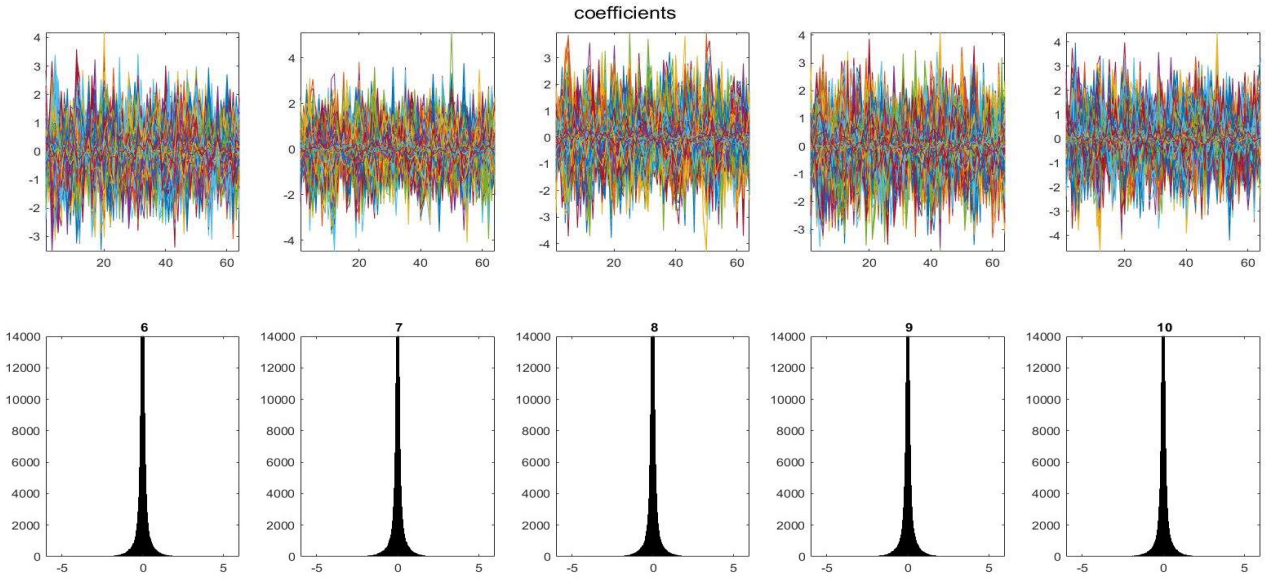


We can see that although some patches have more fluctuate in time and some are always in same range, average on all patches in time is somehow the same in different times.

Now let’s take a look at coefficients for each frame:

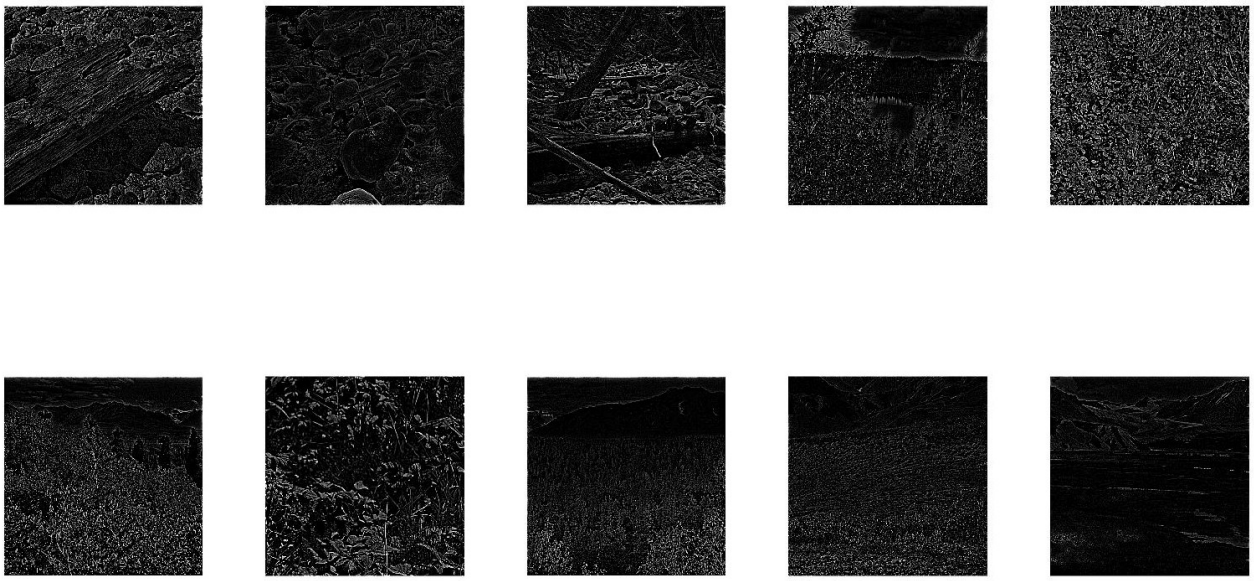
Here coefficient is calculated for each frame set, We cannot see any important difference between histograms.





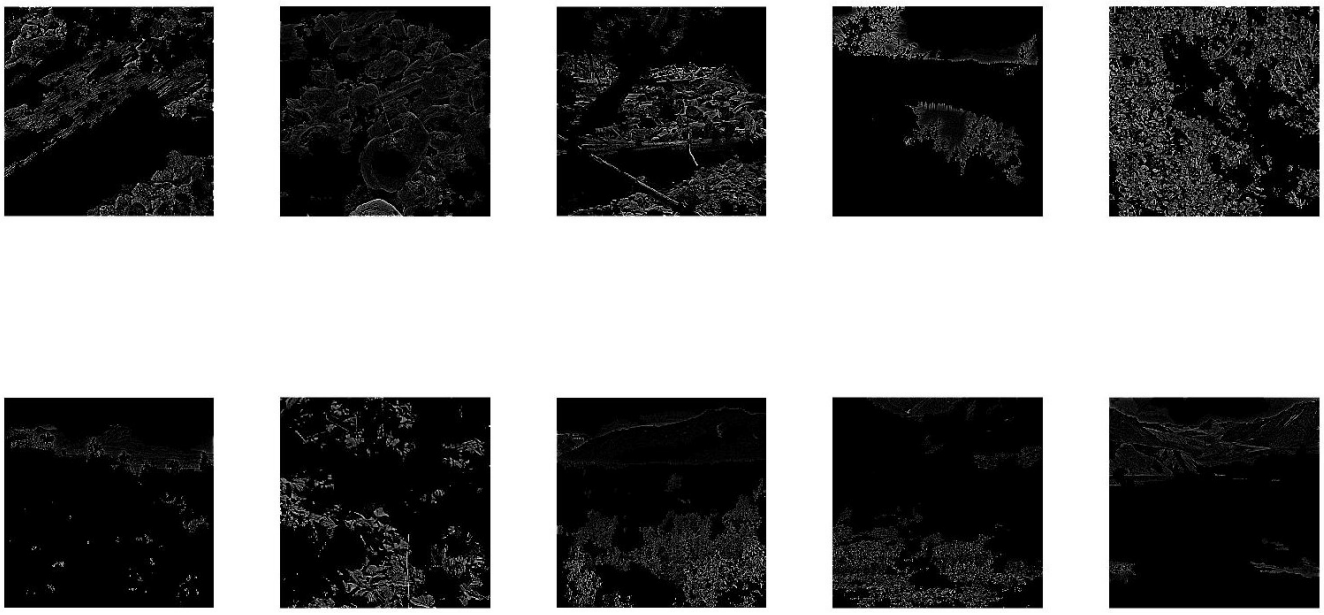
Step4: Difference between the basis functions extracted from the salient parts of the images and those extracted from the whole image:

Whitened Orginal Images

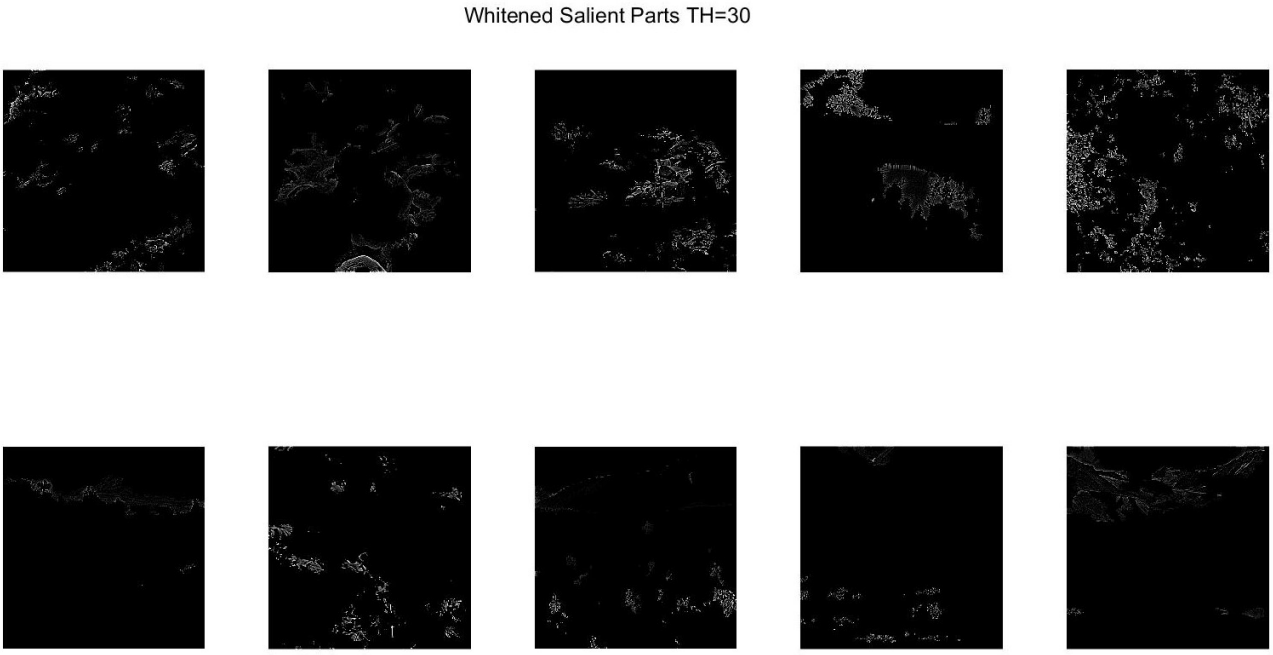


Here to find salience parts of images, we want to get the image salient parts and assign a score to them. Select the parts of the salinecy map that have a higher contrast than the defined threshold, and merge the number of that piece into another matrix. Then we keep the parts that are salience and remove the rest of the parts. The size of the images is 512x512 and the matrix of the pieces will be 128x128. Here original image and salient image by threshold equal to 20 are showed.

Whitened Salient Parts TH=20



Scoring method: By obtaining the contrast for the 8x 8 image pieces, we hold the patches that have a higher contrast than the threshold and remove the rest. We considered the threshold once as 20 and once as 30. Here original image and salient image by threshold equal to 30 are showed.

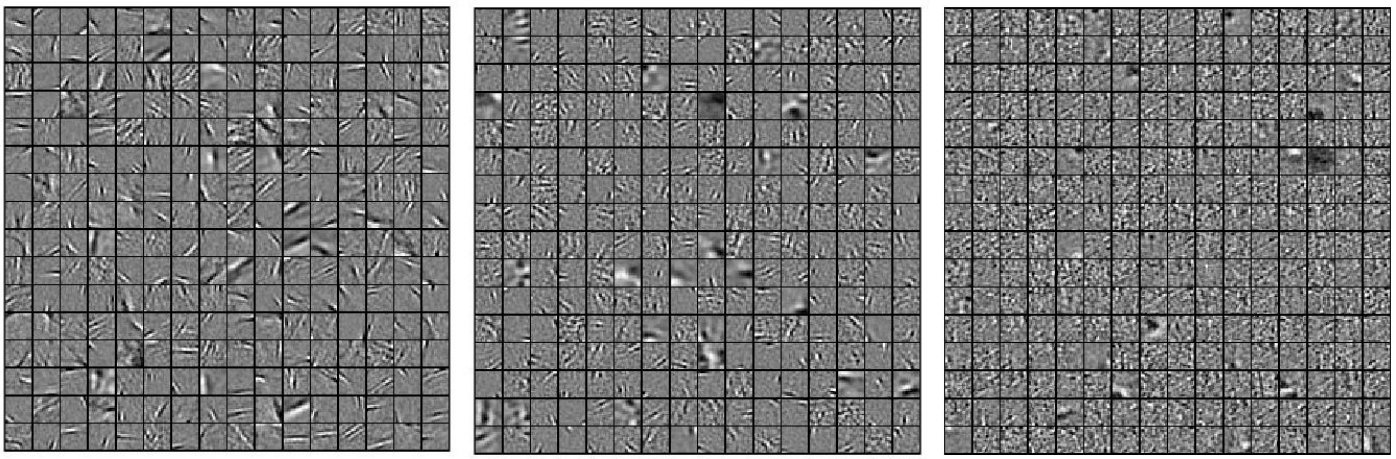


Sparse representation for 256 Basis functions on 8x8 patches:

original images

salient parts
threshold = 20

salient parts
threshold = 30



It can be seen that basis functions on patches which were chosen from whole image are more transparent. The reason is that whole image codes more detail and information about image and in salient parts which are similar to each other, there are less useful information than whole image. But for very large thresholds, there are not enough patches for the network so it will not learn good basis functions.