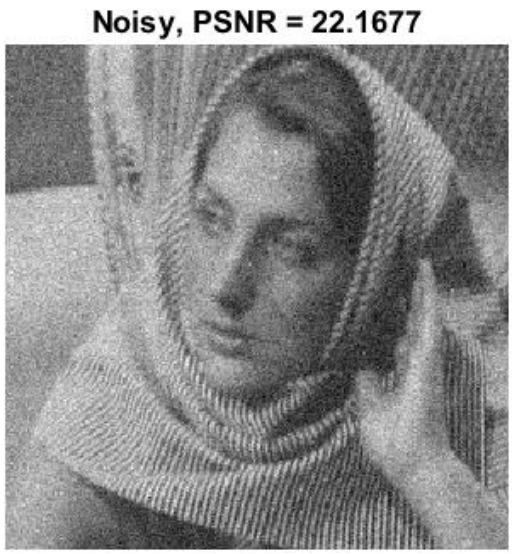
Final Project Report

Part A: Data Construction and Parameter-Setting:



Insert PSNR value of noisy image: 22.1677

Part B: DCT Dictionary

How is the error constraint satisfied for each patch in batch mode?

When we compute the representation of each noisy path with batch thresholding, we compute the energy per atom and patch (a n-by-N matrix), sort and find the cumulative sum for each patch and extract the indices of the elements that are above the squared residual error allowed per patch.
The index of the first energy element per patch that crosses the squared residual error allowed gives us a way to know the cardinality required for representing the patch.
The indices of the correlation coefficients between the patches and dictionary below the necessary thresholds are nulled and the patches are reconstructed.

Insert average MSE of the reconstruction: 414.92

Insert average number of non-zeros of the reconstruction: 5.95

Discuss the obtained values below

On average it was a obtained a sparse representation for each patch and the mean square error also improved in relation to the noisy image.

DCT reconstructed image:

DCT reconstructed image

Enter epsilon value: 209.7618

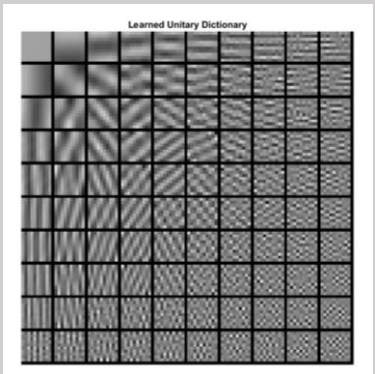
Enter PSNR of reconstruction: 30.2225

Discuss the obtained results below:

The image was denoised, but some details were lost, and the image is blurrier than the original.

Part C: Procrustes Dictionary Learning

The obtained learned dictionary:

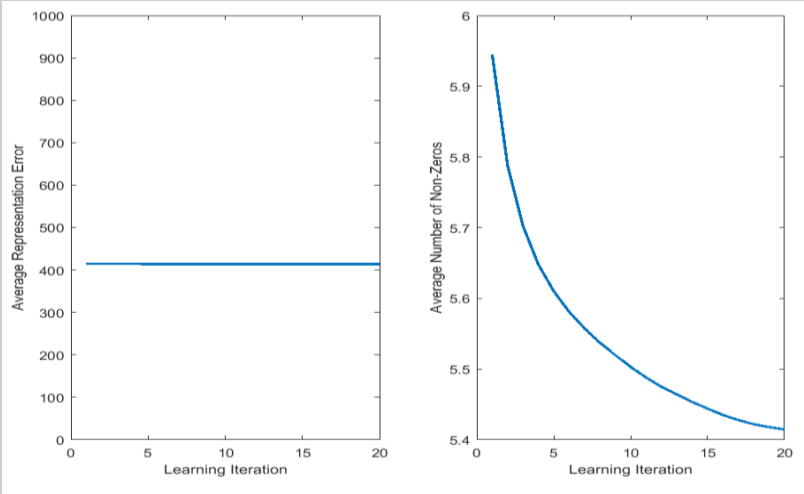


Learned dictionary

Discuss the obtained dictionary:

The learned dictionary matches the pattern (intensity, orientation and scale) of the fabrics and other characteristics in the image. Also, there was a bias correction to match the gray level intensity in the image.

Average MSE and number of nonzeros as a function of the iteration:



Discuss the obtained curves:

The average representation error remains constant across the 20 iterations. The average cardinality decreases and does not seem to have stabilized after only 20 iterations. The calculated representations are indeed sparse, and the dictionary learning is helping to find even sparser representations for the patches.

Procrustes reconstructed image:

Procrustes reconstructed image

Enter epsilon value: 209.7618

Enter PSNR of reconstruction: 30.5899

Discuss the obtained results below:

The image was denoised, but some details were lost, and the image is blurrier than the original. The learned dictionary has an improvement of 0.3674 PSNR in comparison with image reconstructed with the DCT dictionary.

Compare the results of the DCT dictionary and the learned dictionary:

The learned dictionary performs slightly better for this image than the DCT dictionary. The reconstructed images look similar.

Part D: SOS boosting

SOS-boosted reconstructed image:

Enter epsilon value: 230.738

Enter rho value: 1

Enter PSNR of reconstruction: 30.703

Discuss the obtained result and compare to DCT and learned dictionary:

The average cardinality (8.05) was greater than the average cardinality obtained without SOS boosting (5.41) but the PSNR improved 0.1121 in comparison with the reconstruction with the learned dictionary. From the trials done (rho= {0.5,0.7,1.1,1.7}), rho=1 produced the best results in terms of PSNR.