Final Project Report

Part A – Data Construction:

Discuss advice 2:

The advice talks about the possibility of zeros columns in CA which is the dictionary after we remove the rows corresponding to corrupted pixels.

Zeros columns essentially mean we should not use them in the corresponding reconstruction because they provide no information and they can have infinite weight without changing the outcome.

This is not a problem because our algorithms won’t choose these columns any way and the only modification is to add a small epsilon, so we won’t divide by zero

Show two clean images and their corresponding noisy and corrupted versions



Part B – Inpainting by the Oracle Estimator

45.198

Insert average PSNR result of the Oracle estimator:

Show clean, noisy, corrupted and Oracle-based reconstruction:







Part C – Inpainting by Greedy Pursuit

35.949

Insert average PSNR result of OMP:

Show clean, noisy, corrupted and OMP-based reconstruction:



Corrupted image





Compare between Oracle and OMP reconstructions:





Discuss results of OMP and compare to Oracle performance:

We can see that the OMP is not far from oracle but still it have some atoms it got wrong however the atom It got wrong are usually with small coefficients and that’s because they aren’t there in the original image but the noise contribute masquerades as these atoms this can be negated if we won’t consider atoms that have small coefficients to the final solution

Show average PSNR of OMP as a function of



The true cardinality of the solution is 10 and we can see the best PSNR result are obtain when k=12 which is not the true cardinality this can be explained by the fact the when and if we choose all the correct atoms we are not accurate with their coefficients because we estimate them when the noise is present this is why when we add more atoms to the possible solution we can match better to the real solution using atoms that are not in the real solution and there for get closer to the real result a way to deal with that is to notice that the PSNR get much better with every atom we add but after we reach the true cardinality it doesn’t improve by much we can think of an algorithm that check how much we improve form the noisy image and if we don’t improv by much we know we have reached the true cardinality

We can do the check subtracting the reconstructed image from the noisy input and see how much noise is left and if by adding atom we don’t change the MSE of the noise much we know we probably passed the true cardinality (obviously that solution depends on the type of problem and energy of the atoms and of the noise)

Discussion regarding the average PSNR as a function of :

Part D – Inpainting by Basis Pursuit

35.052

Insert average PSNR result of Basis-Pursuit:

Show clean, noisy, corrupted and BP-based reconstruction:



Clean image



Compare between Oracle and OMP and BP reconstructions:







Discuss results of BP and compare to greedy methods and to the oracle performance:

We can see that both the ADMM BP and the OMP achieve pretty much the same results and bout are pretty similar to the oracle with both having some more atoms with small coefficients. However, when we run the BP it take much longer to compute.

Show PSNR as a function of :



Discuss how affects BP reconstruction:

According to the equation:

We can see that controls what we Want the result to be close to the original signal but not sparse or sparse but not as close to the signal. Large means more sparse and small means closer to the input signal.

We can see the there is a that gives the optimal result which is not to sparse because we can’t fully represent the original signal with not enough atoms, and not to dense because we capture the noise as well.

Part E – Effect of Parameters

Show MSE as a function of and :





Discuss the effect of :

P represent how much of the signal we omit p=1 means we get all the pixels and p=0 mean we get non. We can see that P has a direct effect on the MSE of the result and this can be easily explained because if we have more of the signal we can more accurately represent, and the noise have less influence on the reconstruction.

Discuss the effect of :

Sigma is the amount of gaussian noise we add to the signal and we can see that for the tested sigma, the influence on the result is small and this is because OMP is good at denoising and is not influence much by the noise.