



Mini Project 2

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1 Question 1

Run the `ps_sparse_demo.m` for different model orders 4, 8, 16, and 32. *(10 points)

1. Report the recon error for each case.
2. Why you think the recon error are different for each case.
3. Display reference Frames 5 and 120, undersampled Frames 5 and 120, and reconstructed frames 5 and 120.

The reconstruction error are as follows:

1. For $r=4$, reconstruction loss is **0.052908**.
2. For $r=8$, reconstruction loss is **0.038981**.
3. For $r=16$, reconstruction loss is **0.031291**.
4. For $r=32$, reconstruction loss is **0.027579**.

Model order determines the number of principal components used to represent temporal subspace. Taking small value of r allows more sparse representation of temporal subspace but can cause loss of information as less number of principal component are used. As we increase model order, more information are incorporated in the temporal subspace which can lead to better reconstruction.

2 Question 2

Run `ps_sparse_demo.m` for different numbers of navigators, 2, 4, and 8. Set model order = 32. *(5 points)

1. Report recon error for each case. Do you notice change in recon error and quality of recon images?
2. Plot first 2 temporal bases for each case. Are these first two navigators for each of the cases same or different? Give your arguments for your answer.

The reconstruction error are as follows:

1. For $N_{nav} = 2$, reconstruction loss is **0.028501**.
2. For $N_{nav} = 4$, reconstruction loss is **0.027579**.
3. For $N_{nav} = 8$, reconstruction loss is **0.026727**.

We can see a small decrease in reconstruction loss when we use more navigators. Navigators are used to estimate the motion. The accuracy of estimation of motion increases with the increase in number of navigators used, resulting in better reconstruction.

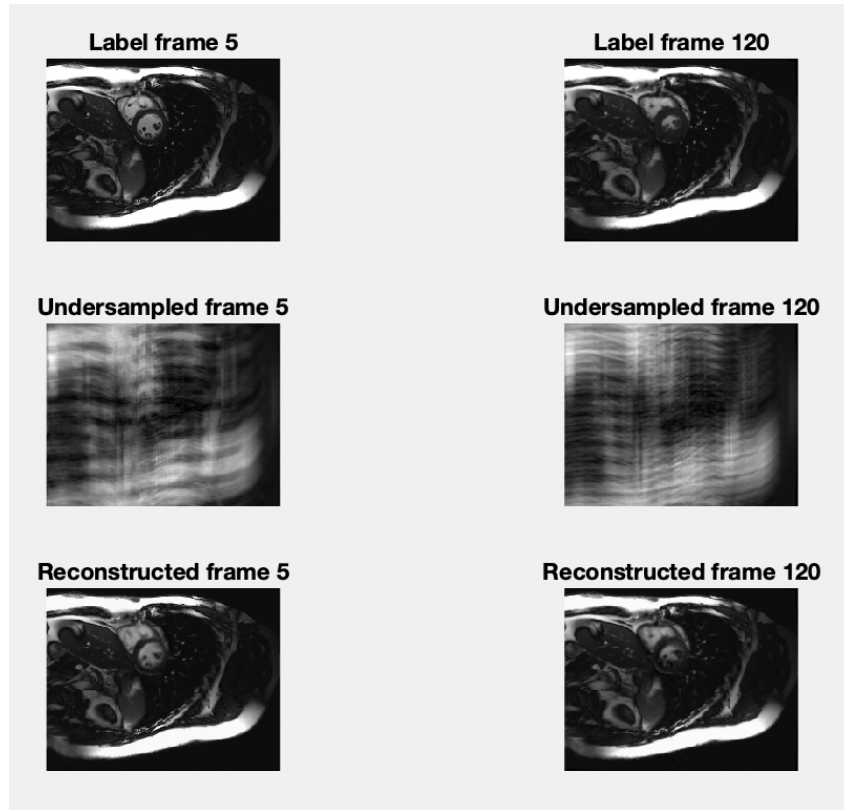


Figure 1: Plot for ground truth, undersampled image, reconstructed image for model order 4

The plot for first temporal basis looks similar in case of 2,4 and 8 navigators, but the second temporal basis is more random for 2 and 4 compared to 8. This can be because second temporal basis capture a more finer details of the motion compared to first temporal basis which vary greatly between the estimated motion.

3 Question 3

Run two experiments. In first set, navigators = 4 and in second set navigators = 40. *(5 points)

1. Plot singular values for each case.
2. Plot first 4 temporal bases for each case. What conclusion can you make from these experiments and plots. (Note, for this you would need to save the second output term in the code where SVD is performed.)

The first temporal basis for both the 4 and 40 navigators are similar, but the subsequent temporal bases differ between them. Moreover, for Navigator 4, all temporal bases except the first one appear to be more random than those for Navigator 40. This may be because the first temporal basis captures the maximum variance in estimated motion, whereas the subsequent temporal bases focus on capturing smaller finer details of motion that can vary significantly depending on the estimated motion. As the number of temporal bases increases, they capture finer details of the motion. Since the motion estimated by 4 and 40 navigator varies, the temporal basis also varies between them.

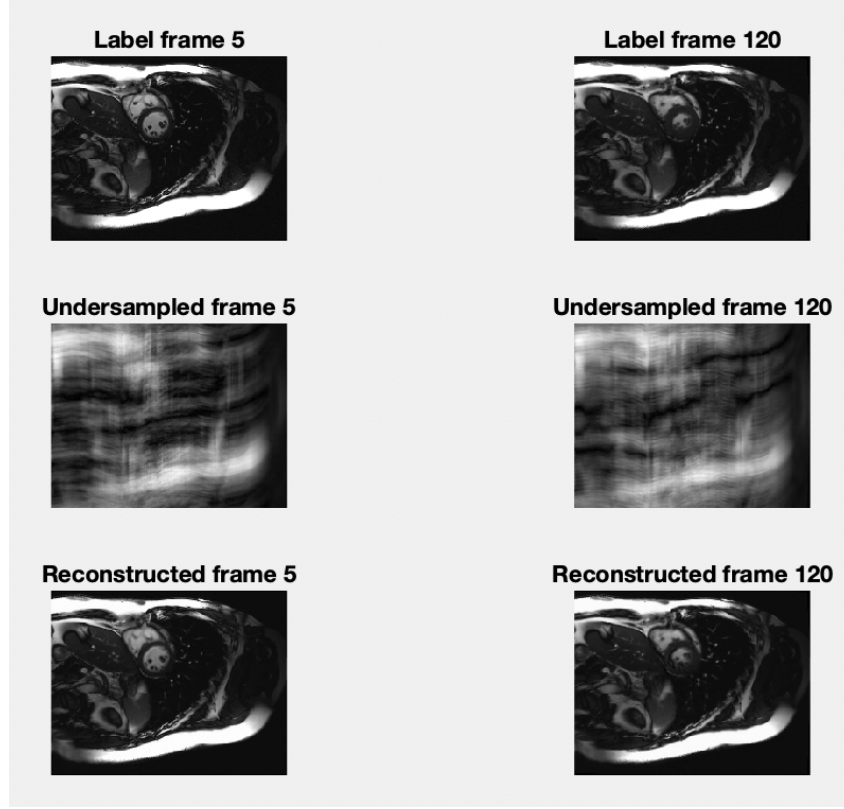


Figure 2: Plot for ground truth, undersampled image, reconstructed image for model order 8

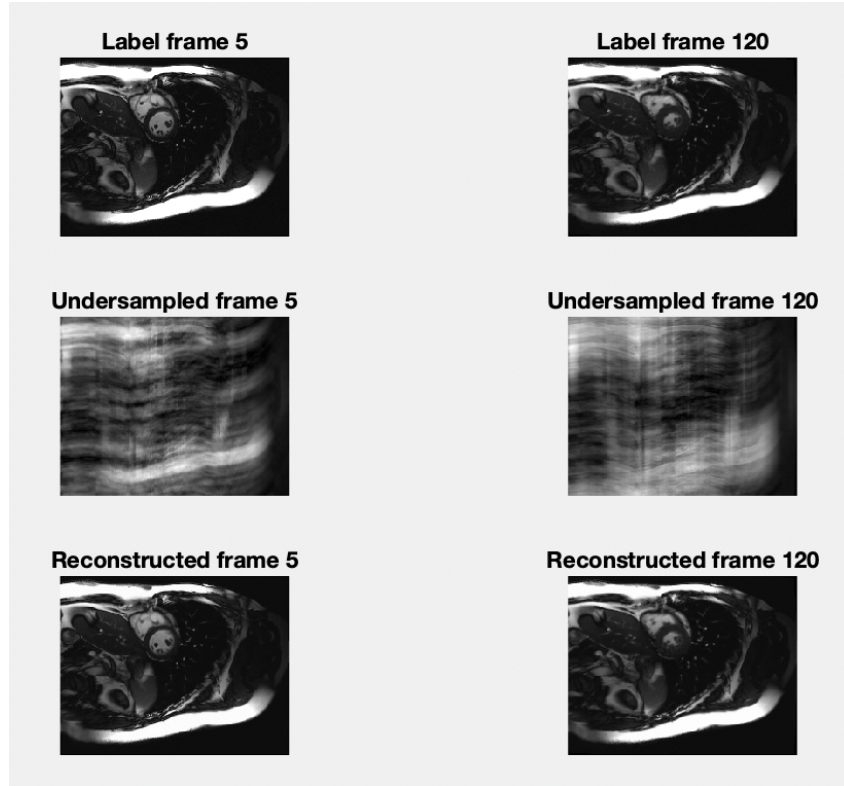


Figure 3: Plot for ground truth, undersampled image, reconstructed image for model order 16

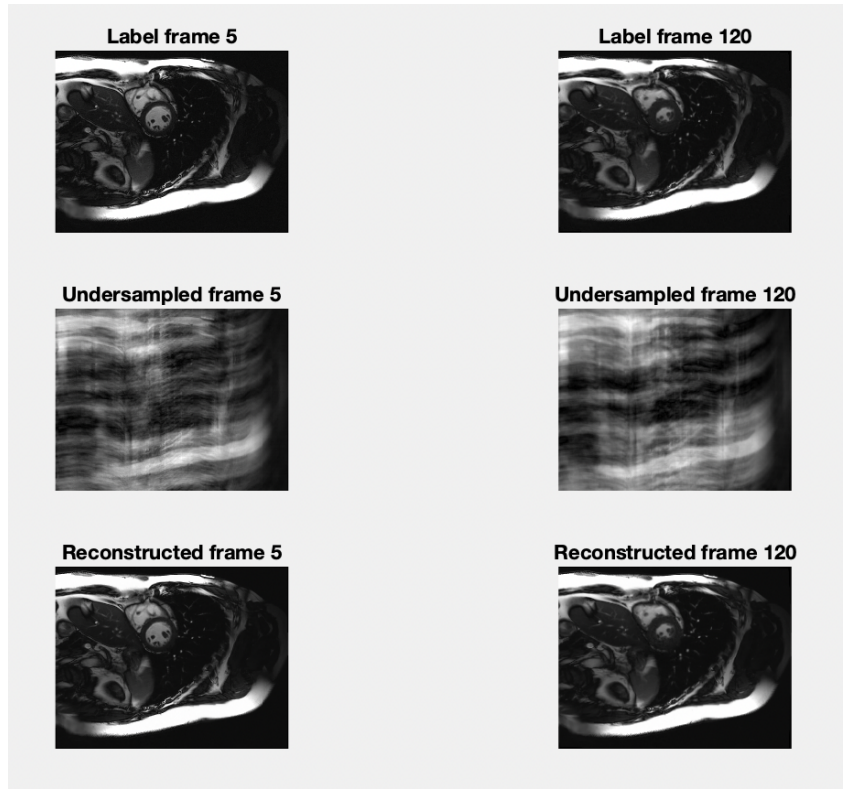


Figure 4: Plot for ground truth, undersampled image, reconstructed image for model order 32

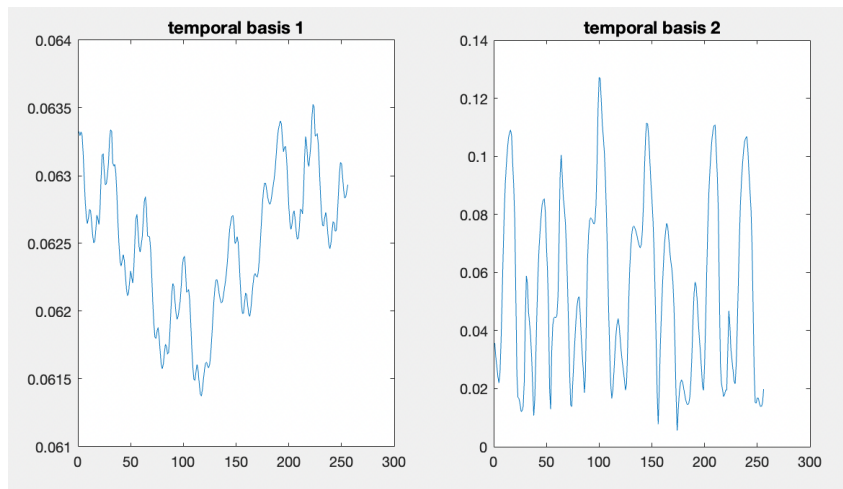


Figure 5: Plot of first two temporal basis with 2 navigators

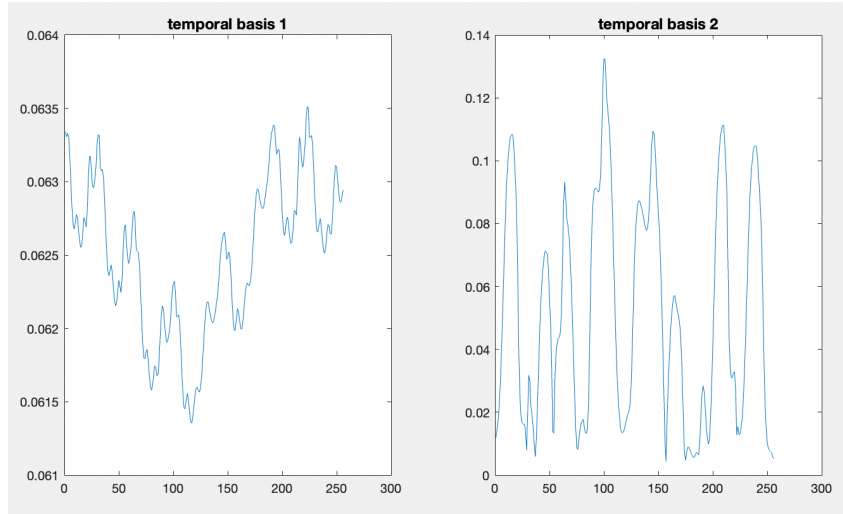


Figure 6: Plot of first two temporal basis with 4 navigators

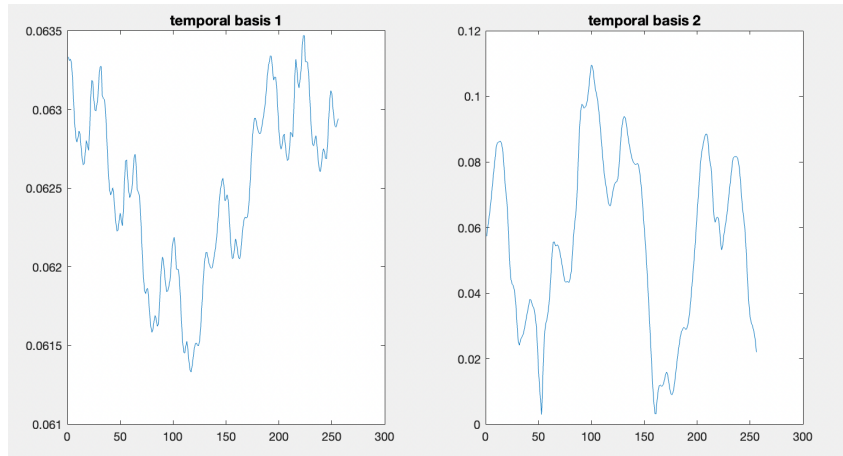


Figure 7: Plot of first two temporal basis with 8 navigators

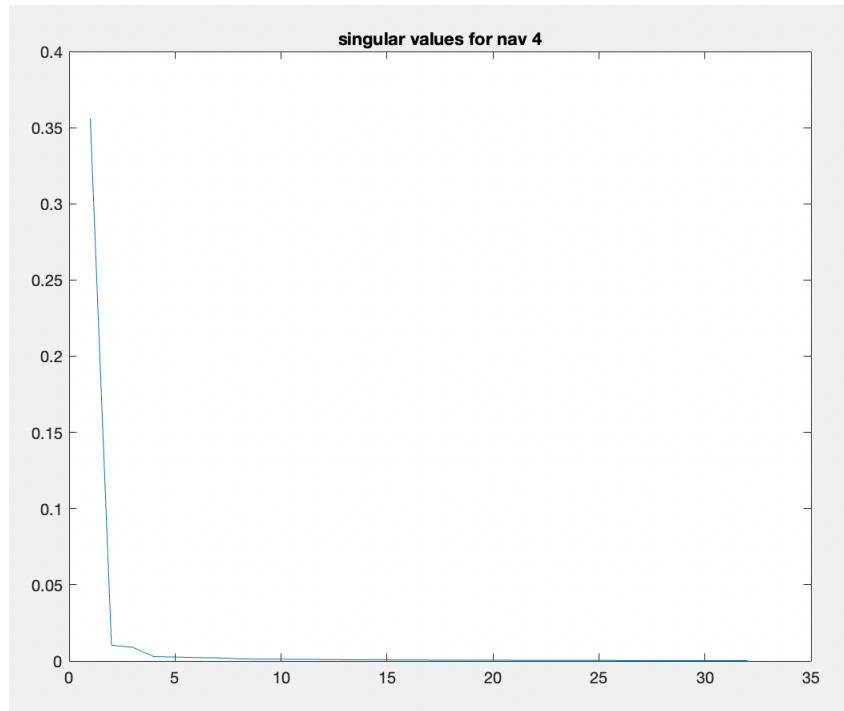


Figure 8: Plot of singular values while number of navigator is 4

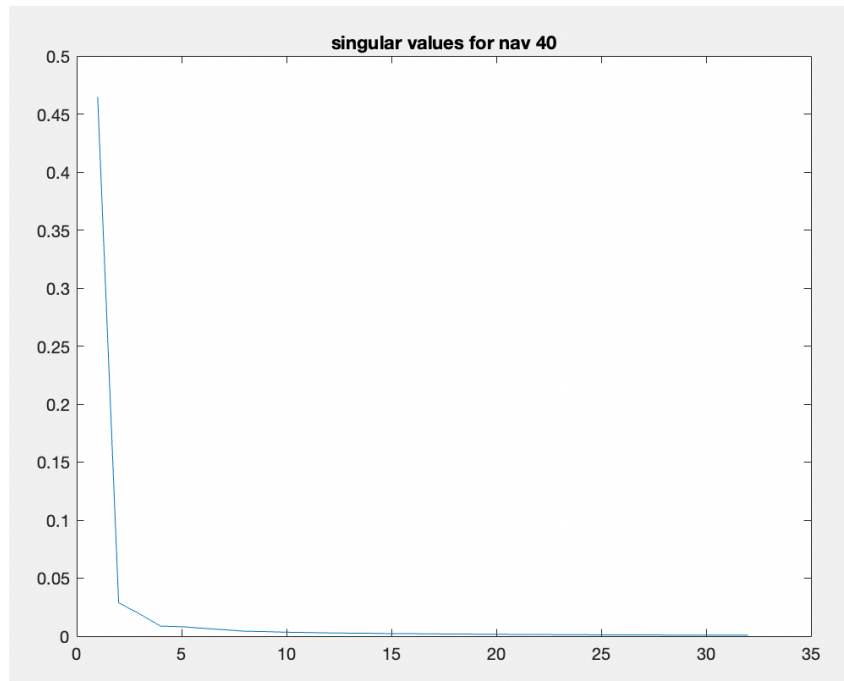


Figure 9: Plot of singular values while number of navigator is 40

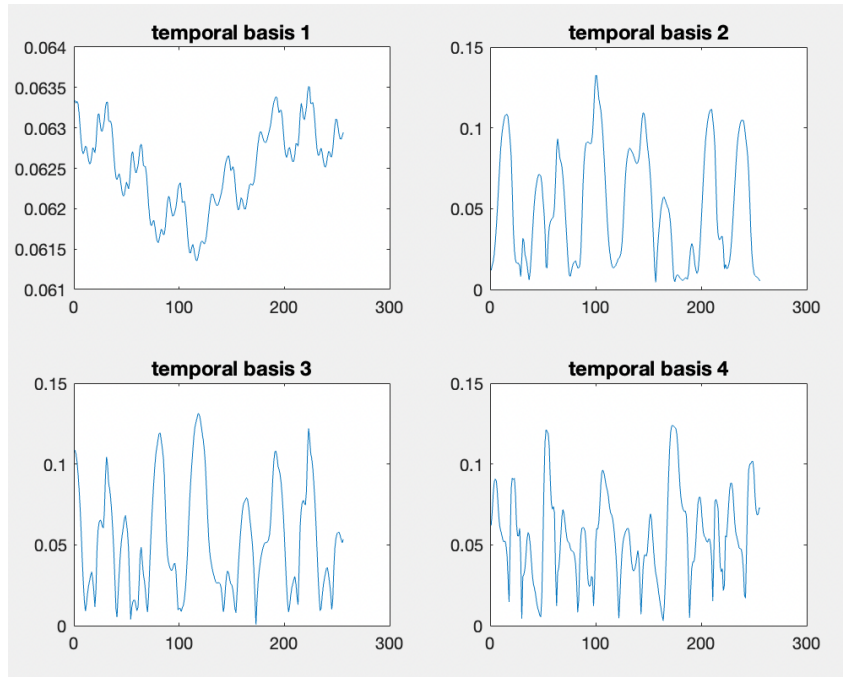


Figure 10: Plot of first four temporal bases with 4 navigators

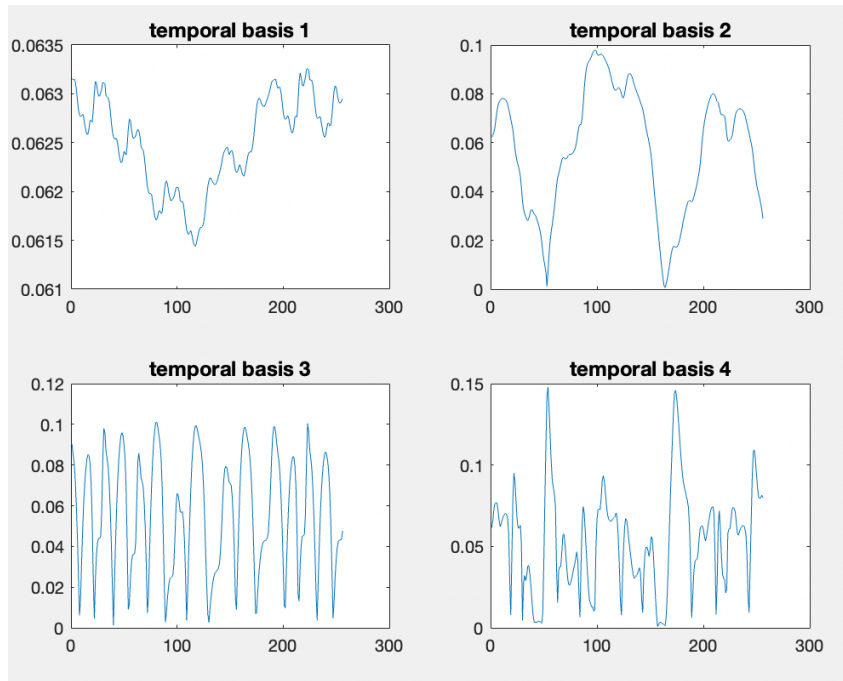


Figure 11: Plot of first four temporal bases with 40 navigators