ASSIGNMENT-8

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Questions and Answers

Question-1: The plots below show two example sinc pulses. How will you generate pulses that look like this? Which parameter should be changed? What effect do you think this will have on the final image?

- For generating the pulses similar to the given diagram we have to adjust the value of C and SincP(increasing C and reducing SincP). I have demostrated it in the jupyter notebook for C=5 and SincP=5.
- The parameter SincP is responsible for the two different plots.
- On increasing the value of SincP the plot gets narrower along the x-axis and on decreasing the plot gets wider along the x-axis.
- The value of SincP is larger for the figure-2 when compared to the figure-1.

Question-2: Does it make sense to reconstruct up to Nsamp? What value is more reasonable as an upper limit for the x-axis here?

- Here the mics are placed symmertrically. So resonable upperlimit would be Nsamp//2.
- Reconstructing upto Nsamp would be a safer option but not optimised one.

Question-3: The (x, y) coordinates corresponding to the maximum amplitude (yellow colour) is approximately (30, 22). Explain why this is the correct expected position for the given obstacle.

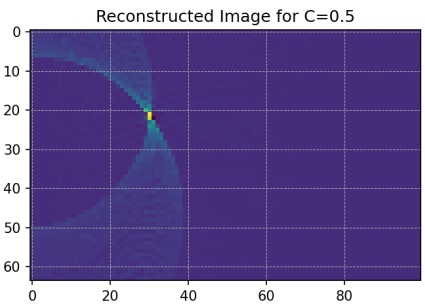
- The calculations for the x and y coordinates are as follows:
- The **x-coordinate** is calculated by multiplying the sample number (30) by the distance per sample (dist_per_samp = 0.1), resulting in an x-coordinate of 3 units from the origin.
- The **y-coordinate** is calculated by multiplying the microphone number (22) by the pitch (0.1), resulting in a y-coordinate of 2.2 units from the origin.
- If the central microphone is placed at the origin and its position is 3.2 units, then the source is 3.2 - 2.2 = 1.0 units away from the central microphone. Thus the source would indeed be at (3, -1) in this coordinate system.
- This means that the source of the signal is located at (3, -1) if we consider the position of the central microphone as the origin. It satisfies the given position of the obstacle.

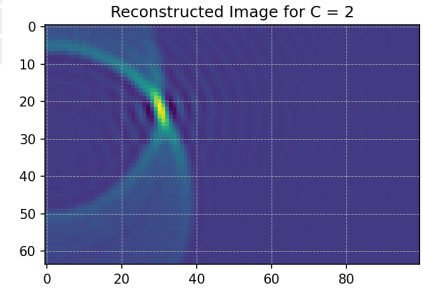
Question-4: What is the maximum obstacle x- and y- coordinate that you can use and still have an image reconstructed?

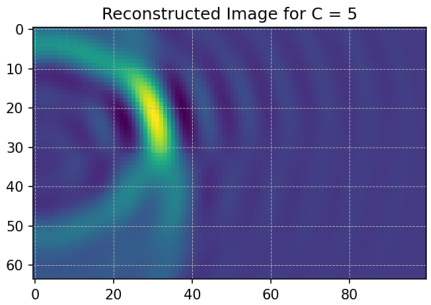
- The **maximum x-coordinate** is determined by the number of samples (Nsamp) and the distance per sample (dist_per_samp). The maximum x-coordinate would be (Nsamp//2) $*$ dist_per_samp.
- The **maximum y-coordinate** is determined by the number of microphones (Nmics) and the pitch. The maximum y-coordinate would be (Nmics//2) $*$ pitch.

Question-5: What happens if C is different - if C is decreased it looks like the image becomes sharper. Can you explain why intuitively?

- Yes On decreasing the C the images becomes sharper.
- When C is decreased, the calculated time delays between the microphones and the source increase. This means that the differences between the arrival times of the signal at each microphone are more pronounced.
- Intuitively, we can think of it like this: if the sound (or other waves) travels slower, it takes more time for it to reach the different microphones. This makes it easier to tell exactly where the sound came from, because the differences in arrival times are larger. It's similar to how it's easier to locate the source of a slow-moving sound in a quiet room, compared to a fast-moving sound in a noisy environment.



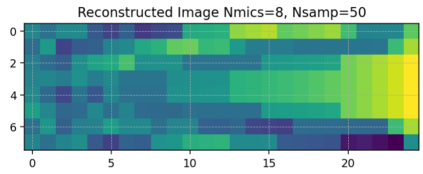


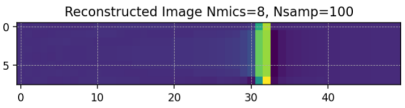


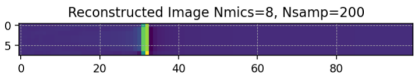
Question-6: What happens if Nmics is increased or decreased? Do the experiments with Nmics = [8, 32, 64] and Nsamp = [50, 100, 200] (all combinations). Attach the resulting images

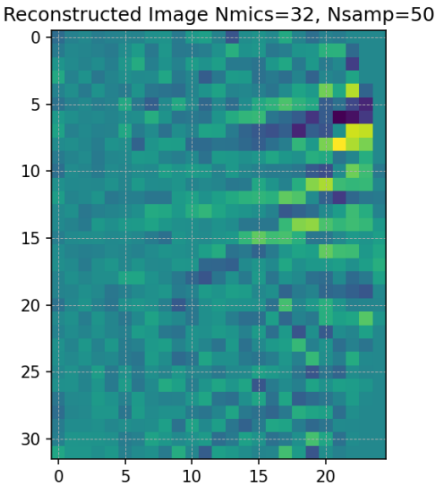
- On increasing the Nmics, leads to a higher resolution in the reconstructed image because we have more data points to work with. But it may increases the computational complexity of our code.
- On decreasing the Nmics the image appears more blurry(less detailed). But the computational complexity of our code might be reduced.

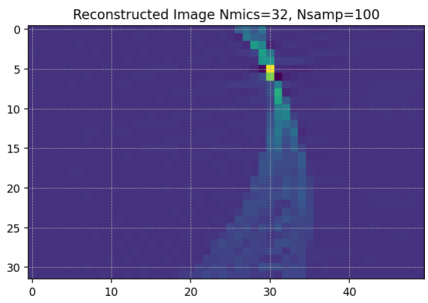
The following plots are plotted for obstacle = (3,-1) and C = 0.5, pitch = 0.1, dist_per_samp = 0.1, SincP = 5:

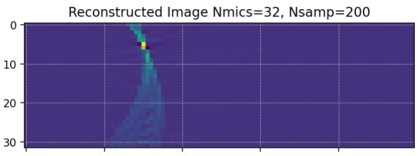


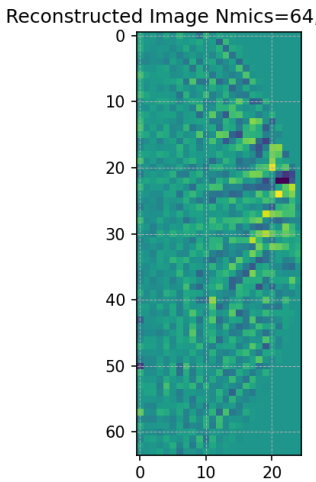


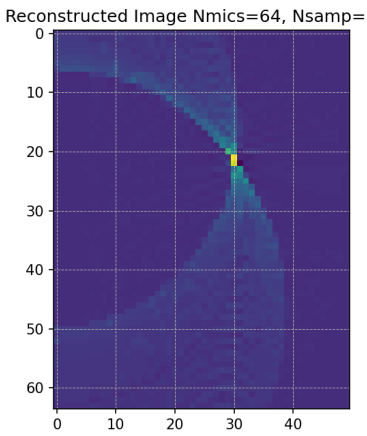


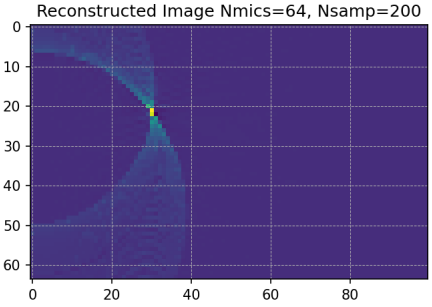












RX2.TXT

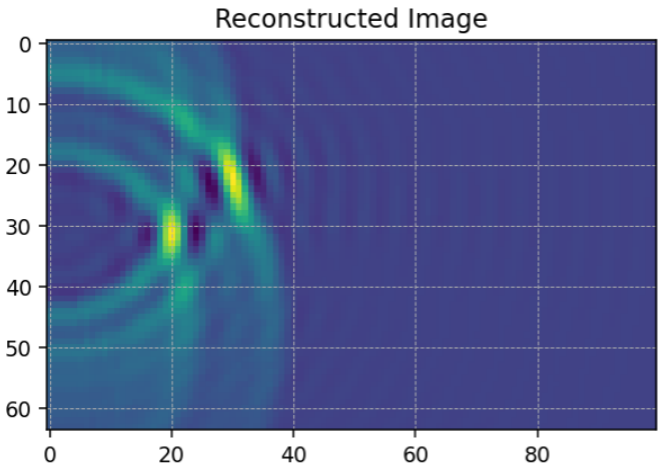


Figure 1: rx2.txt

- Form this plot we can find that there are two sources.
- Which are approximately at (20,30) and (30,22)

RX3.TXT

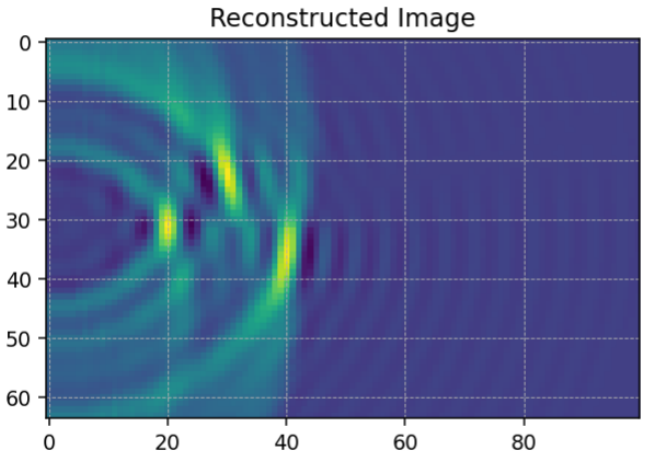


Figure 2: rx3.txt

- Form this plot we can find that there are three sources.
- Which are approximately at (20,30), (30,22) and (40,38)