Assignment-7

Deenabandhan N
EE23B021

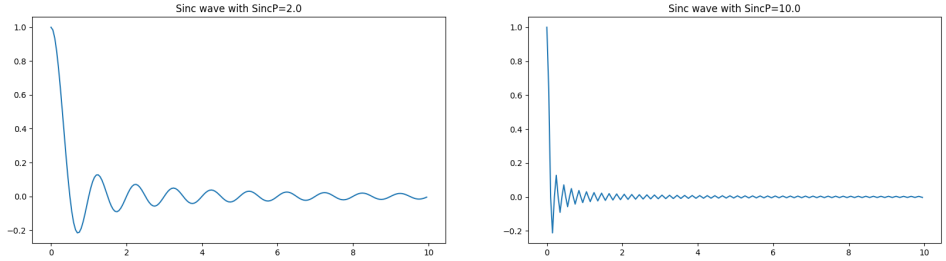
November 6, 2024

Introduction :

- In this experiment , we tried to use **DAS** algorithm to find the position of obstacle.
- In this report , I have answered the questions asked in the assignment , for verification you can run the notebook attached.
- Important thing to note is that , I have defined all parameters to be a global variable. So it is recommended to run the global variable cell before running any other cell.

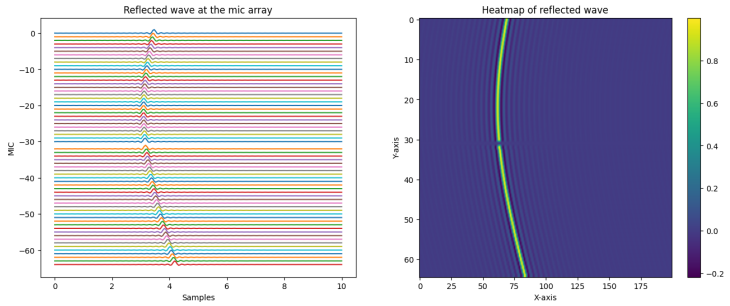
SincP parameter :

- SincP parameter given in the assignment is the one that affects the rate at which the function dies or determines the sharpness of the sinc function.



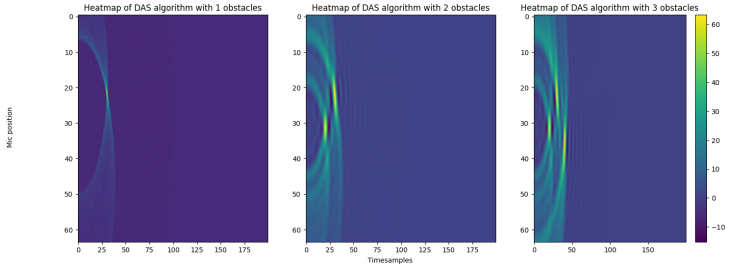
Reflected wave

- I have created a function sample_out() to generate values of sinc function at various time samples for each mic in the mic array.
- The result is shown below.



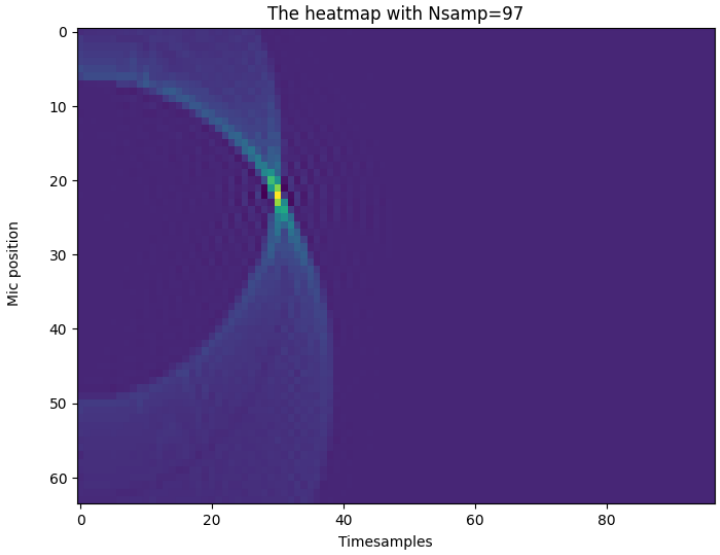
DAS algorithm :

- The function dac_imp() takes in the data array that has the value of sinc function at various time intervals for various mics.
- This function will return the grid that contains the sum of the values of the sinc function at the particular delay.
- The following figure shows the result of 1,2,3 obstacles.



Reconstructing Nsamp and upper bound for x-axis

- The DAS algorithm will find the time delay of each point in the grid and goes to the specific position in the given data array and sums up the amplitudes of each mic.
- But in most of the cases , the position where the maximum delay happens will either be way smaller than **Nsamp** or it will exceed in which case , we don't care.
- So , I have created a global variable called **min_samps** that finds this minimum number while running the DAS algorithm.
- For the one obstacle case , it is 97 and the resultant plot is as follows,



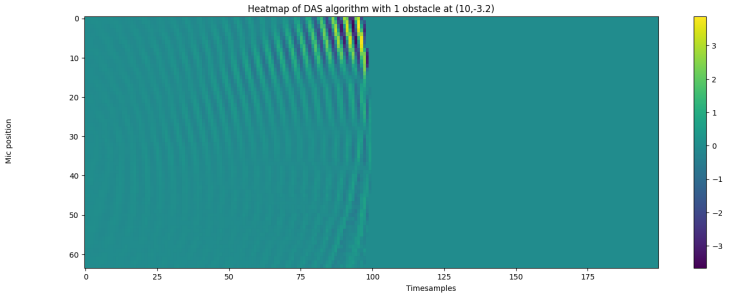
Final Questions :

(x,y) coordinates

- The maximum amplitude happens at (30,22).
- The reason is the unit of X-axis is (1 unit = 1 distance per sample) which is 0.1 so x_coordinate is 3.
- Similarly in Y-axis (1 unit = 1 pitch starting from -(Nmics*pitch)/2.
- Therefore 22 will be 1.2 unit away from -3.2 which is -1. Therefore the coordinate of obstacle is **(3,-1)**.

Maximum x,y coordinate of obstacle

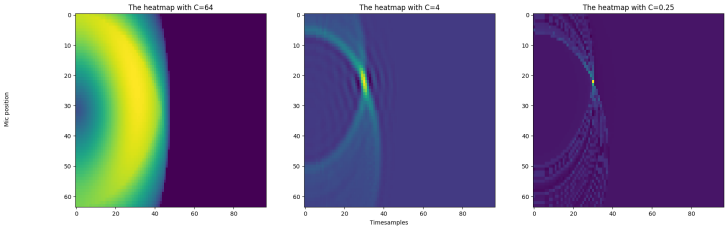
- From the above discussion the maximum possible y-coordinate of the obstacle can be at the edge of the mic position.
- The maximum possible x-coordinate of the obstacle can be at a point such that the time delay is atmost (Nsamps*dist_per_samp/C).
- Therefore , for the parameters , (Nsamp=200,dist_per_samp=0.1 and C=2) the maximum possible x coordinate is 10.



Changing C value

- The sharpness of image is attributed to how close the time samples are. This is due to the fact that we are trying to analyse the amplitude of the sound wave at different grid points.
- While doing so , we evaluate them by finding the time difference taken by these points whose precision will increase as we increase the C value.

- The difference between two time samples is given by $\boxed{\frac{dist\_per\_samp}{C}}$.
- So increasing C will help us closely analyse the adjacent two points by giving us more accuracy over time difference.
- The following diagram shows the variation of heatmap wrt C value.



Effect of Nmics

- The value of Nmics helps us determine the relative position of the maxima as more the number of points , better the amplitude variation will be.
- The reason for the above statement is in DAS algorithm we iterate through all the mic array and add the amplitudes of respective time delay.
- This sum will differ among all the grid points if there is multiple mics to get samples from.
- The following plot shows the variation ,