BMED311 Hands-on : Sampling and Aliasing

Demo for aliasing

1. Run con2dis.m, vary the parameters, and observe the resulting signals to review the concept of aliasing.

Comparing Frequency of the component.

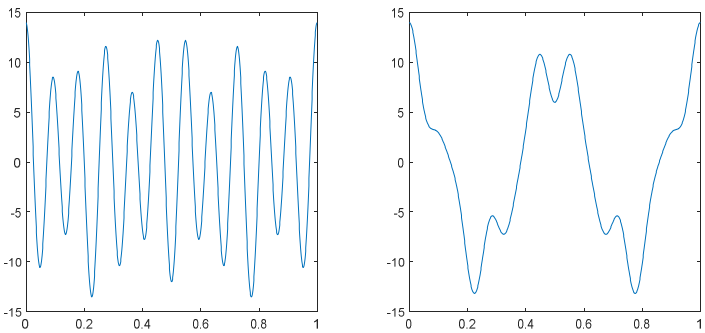
2. Generate a time vector t from 0 to 1 with a sampling interval sufficient to satisfy the Nyquist criterion. Create and plot three cosine waveforms as described below.

$$\mathrm{a}_1(t) = \cos(2\pi(11)t),\ \mathrm{a}_2(t) = \cos(2\pi(7)t),\ \mathrm{a}_3(t) = \cos(2\pi(2)t)$$

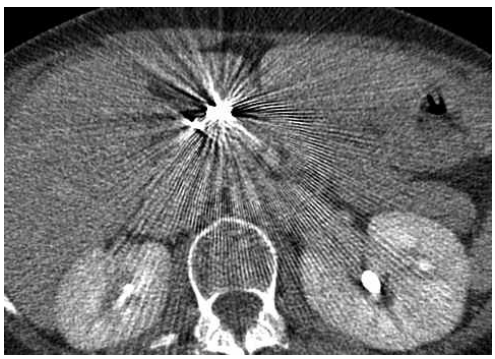
3. Create two sums of sinusoids as described below and plot the sinusoids. Finally, Compare the two sinusoids. Which sinusoid mainly contains high frequency components?

$$b_1(t) = 10a_1(t) + 3a_2(t) + a_3(t)$$

$$b_2(t) = a_1(t) + 3a_2(t) + 10a_3(t)$$



Aliasing on image data



4. Read the abdomen.bmp file in MATLAB and store the data in the array xx. (Hint: imread)

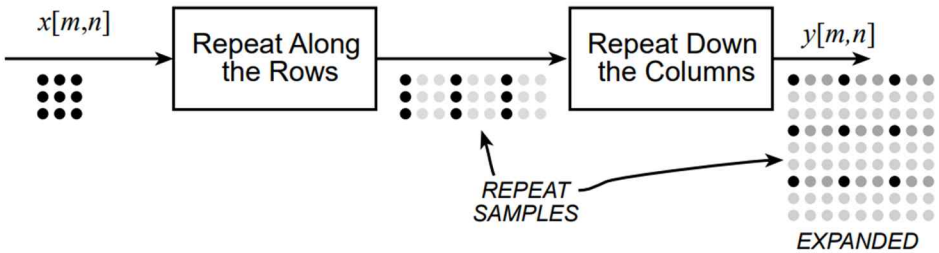
5. Now that the array xx contains the image information, verify the maximum and minimum values of xx.

6. Display xx on your screen. (Hint: imshow)

7. Identify which parts of the image primarily contain high-frequency components and which parts primarily contain low-frequency components. Support your answer by examining 1D profiles across the image.

Down-sample the signal.

8. Downsample xx using a 3:1 ratio and store the resulting image in the array 'xx_down'. Then, display xx_down on your screen. (Hint: xx(1:interval:end, 1:interval:end)). Were aliasing effects expected? If you observe aliasing, where in the image does it appear? Explain why these effects are observed in those specific areas.

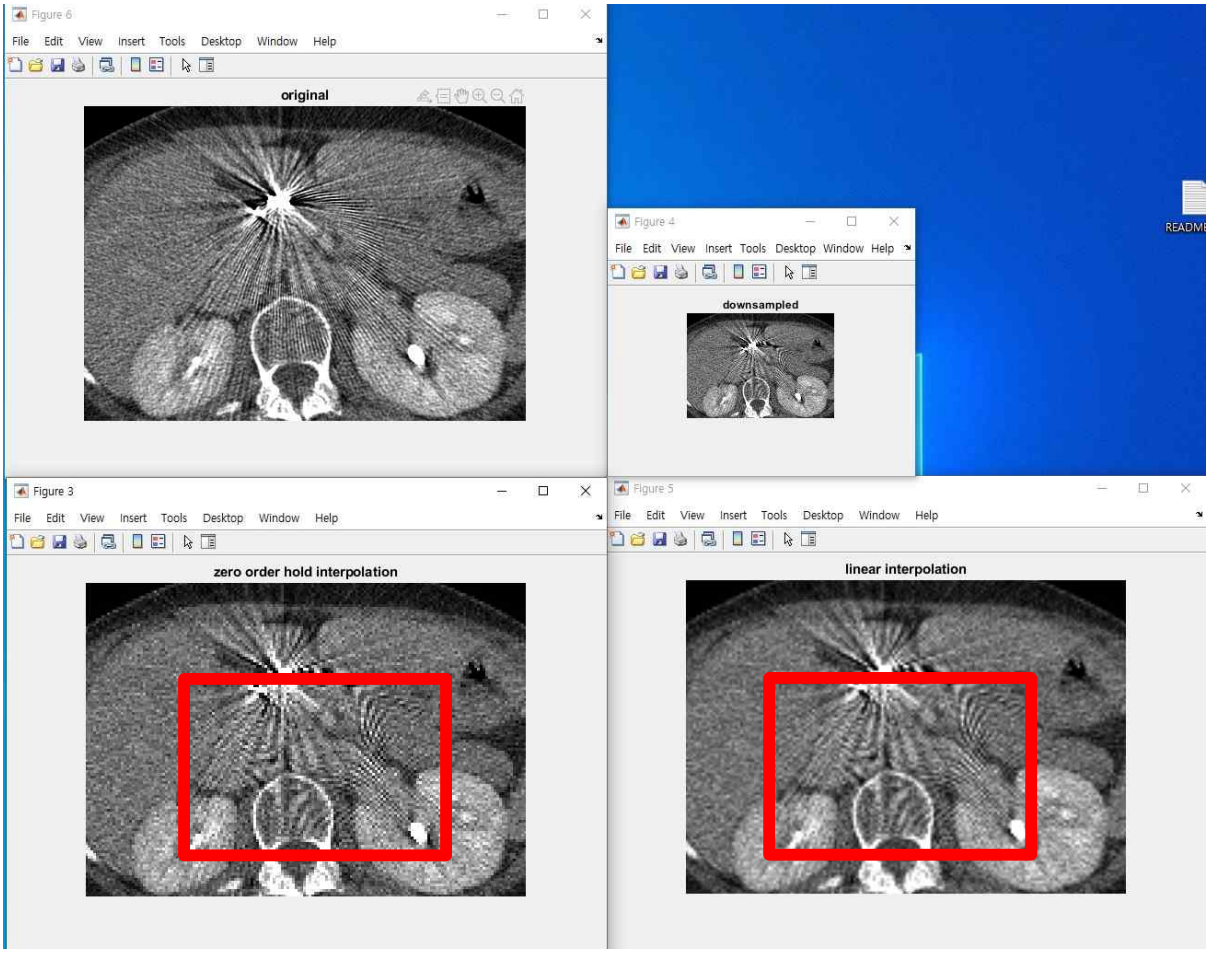


Reconstruct the original signal from the down-sampled signal.

9. Reconstruct 'xx_down' to approximately the same size as the original image using the zero-order hold interpolation reconstruction method. Finally, display it in a figure. (Hint: interp2(..., 'nearest'))

10. Reconstruct xx_down using the linear interpolation method and display it in a figure. (Hint: interp2(..., 'linear'))

11. Which reconstruction method is better, zero-order hold or linear interpolation (first-order hold)? Describe the reason using comments.



interp1 – returns interpolated value at the coordinate of xq

vq = interp1(x,v,xq,method)

input parameters:

x – sample coordinate vector, v - value vector corresponding x

xq – interpolated coordinate vector

method – interpolation method: 'linear' (default) | 'nearest'

returned value:

vq - interpolated value vector at xq coordinates

meshgrid – 2D coordinate grids: 벡터 x 및 y에 포함된 좌표를 바탕으로 2차원 그리드 좌표를 반환합니다.

[X,Y] = meshgrid(x,y)

Input parameters: x - x coordinate vector(1D), y - y coordinate vector(1D)

Returned values: X - 그리드 상의 x 좌표(2D), Y - 그리드 상의 y 좌표(2D)