CS652 and CS/IT308 Machine Learning

Assignment-1

February 15, 2021

Hint-1: Refer to `http://apps.usd.edu/coglab/schieber/pdf/Intuitive2DFFT.pdf`

Hint-2: Useful Python libraries: numpy, scipy, matplotlib.

Exercise 1

Generate and display following images:

$I_1(n_x, n_y) = Q(\sin(2\pi f_x n_x T))$

$I_2(n_x, n_y) = Q(\sin(2\pi f_x n_x T + 2\pi f_y n_y T))$

$I_3(n_x, n_y) = Q(A + \cos(2\pi T(f_x n_x + f_y n_y)))$

where, $n_x, n_y \in [0, 99]$, $f_x, f_y \in \{1, 10, 20\}$. $Q(f(n_x, n_y))$ quantizes the values of a real function to integers $\in [0, 255]$. T is a sampling time interval. Take the sampling frequency to be 10 times $\{f_x, f_y\}_{max}$. Find out the discrete Fourier transform (DFT) of all the generated images and display them. Interprete your results. Now, change the sampling frequency from 10 times to 2 times the $\{f_x, f_y\}_{max}$ and finally just the $\{f_x, f_y\}_{max}$. Find the DFT of the same and display them. Could you see the aliasing effect? Comment on the symmetry of Fourier transform in 2-D.

Exercise 2

Generate a checker board image with size 100×100 and 256 gray levels. Use only 0 and 255 as alternating block colours. Vary the block size from 2^2, 5^2, 10^2, and 50^2 pixels. Find the DFT of each image. Comment on your result.