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| **Experiment 3** |
| **Title:** **Sampling & Aliasing**  Consider various human voice / speech (probably your voice both male and female) or music signals. Try different sampling rates and observe the effect of aliasing. |
| **Learning Objectives** |
| 1. To understand basic concept of sampling 2. To study effect of sampling on frequency and bandwidth 3. To study magnitude and phase spectrum of signal 4. To have hands on simulation using python language |
| **Prerequisites** |
| 1. Basic understanding of mathematics 2. Basic understanding of signal representation 3. Basic understanding of Python language |
| **Theory** |
| Sampling Theorem:According to Nyquist principle of sampling, in order to remove alising effect signals are sampled with sampling frequency equals to twice of the frequency of signal to be sampled.If F = frequency of signal to be sampledThen, sampling frequency = Fs ≥ 2FSelecting Sampling frequencyEffect of sampling on frequencySelecting closer frequency for samplingResult of sampling after selecting closer frequencySelecting more closer frequency for samplingResult of selecting more closer frequency for sampling |
| **Simulation Code** |
| import numpy as np  import matplotlib.pyplot as plt  from scipy.fftpack import fft  Fs = 1000  n = np.arange(Fs)  t = n/Fs  fc = 300  fc1 = fc + 100  fc2 = fc - 100  xc = np.sin(2\*np.pi\*fc\*t)  xfc1 = 0.5\*np.sin(2\*np.pi\*fc1\*t)  xfc2 = 0.5\*np.sin(2\*np.pi\*fc2\*t)  y = xc + xfc1 + xfc2  Y = fft(y) #taking FFT  Y\_m = (2/Fs)\*abs(Y) #magnitude spectrum  Y\_phase = (2/Fs)\*np.angle(Y) #phase spectrum  plt.subplot(3,2,1)  plt.plot(t, xc)  plt.title('X fc')  plt.xlabel('time t')  plt.ylabel('magnitude')  plt.subplot(3,2,2)  plt.plot(t, xfc1)  plt.title('X fc1')  plt.xlabel('time t')  plt.ylabel('magnitude')  plt.subplot(3,2,3)  plt.plot(t, xfc2)  plt.title('X fc2')  plt.xlabel('time t')  plt.ylabel('magnitude')  plt.subplot(3,2,4)  plt.plot(t, y)  plt.title('y = xfc + xfc1 + xfc2')  plt.xlabel('time t')  plt.ylabel('magnitude')  plt.subplot(3,2,5)  plt.plot(Y\_m)  plt.title('Magnitude Spectrum')  plt.xlabel('Frequency Hz')  plt.ylabel('Magnitude')  plt.subplot(3,2,6)  plt.phase\_spectrum(y)  plt.show() |
| **Assignment** |
| **Task1: Write description for codes**  **Task2: Vary the parameters of the signals and observe the magnitude and phase spectrum** |
| **Conclusion** |
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