EE 240C Homework 2

Vighnesh Iyer

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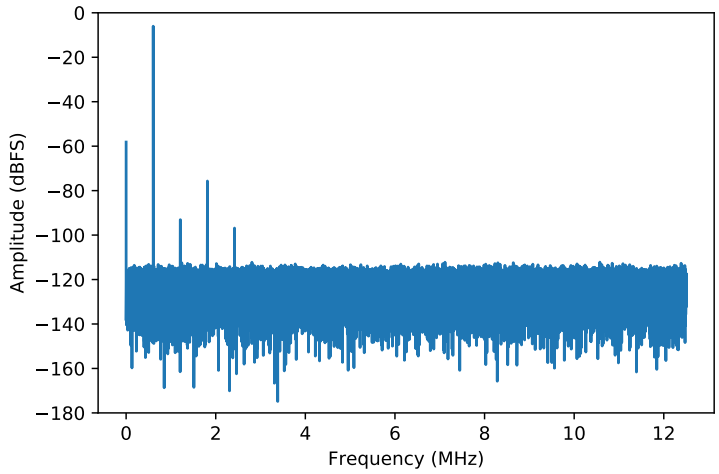
Problem 1: Spectral Analysis

a) Plot the spectrum from 0 to $f_s/2$ using FFT without averaging. The y-axis should be in dBFS while the x axis should be in MHz.



b) What is the frequency f_{in} of the sinusoidal signal at the input of the ADC?

The frequency bin with the maximum amplitude is 3171 which corresponds to a frequency of 0.605 MHz.

c) Compute the following metrics: SNR, SNDR, ENOB, THD, SFDR.

- SNR = $\frac{P_{sig}}{P_{noise}}$ where P_{noise} excludes DC, the signal, and the 2-7th harmonic.
  SNR = 67.9 dB.
- SNDR = $\frac{P_{sig}}{P_{noise}}$ where P_{noise} excludes DC and the signal, but includes the harmonics.
  SNDR = 65.65 dB. This is close to the SNR which makes sense since the harmonics are well below the signal.
- ENOB = $\frac{SNDR(dB)-1.76dB}{6.02dB}$ = 10.6 bits
- THD = $\frac{P_{distortion}}{P_{sig}}$ = -69.5 dB
- SFDR = $\frac{P_{spur,max}}{P_{sig}}$ = 69.6 dB

d) Which non-ideality is limiting the SFDR in this case?

The INL seems to limiting the SFDR. From the equation in lecture $SFDR = 20\log_{10}(2^B/INL)$ which for a 12-bit ADC and 1 LSB of INL equals 72 dB SFDR, which is close to the computed value.