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Homework 5
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EECS 247
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Problem 1:

A 3-bit D/A converter were designed for an ideal LSB level of 50mV. The following output voltage levels were measured for the real D/A for the codes 000 through 111 respectively:

-2mV 52mV 98mV 160V 205V 245V 305V 363mV

- a- Find the offset & full-scale error in units of LSBs
- b- Find the end-point ideal & actual gain in LSB/code and compute the gain error in LSB/code
- c- Find the end point corrected codes and compute DNL & INL for all the codes.
- d- What is the maximum DNL & INL?

Problem 2:

The vector shown below is a ramp histogram of the output codes obtained for a 4-bit ADC.

2480 1102 810 1005 1106 1504 912 1207 1001 802 905 950 1150 600 1203 2302

Preferably write a Matlab program to:

- a- Calculate the DNL and INL for all codes in LSBs.
- b- Find the peak positive and negative DNL and INL.
- c- Include a copy of your program.
- d- Is monotonicity guaranteed for this ADC?

Problem 3:

Shown below is a 4096 point FFT of the output of a 9-bit A/D converter for full scale sinusoidal input.

1. What is the SFDR of the ADC?
2. Estimate the INL of the converter in LSBs.
Note that: the definition of INL requires that the offset and gain of the ADC be adjusted for zero error at the end points. Also, the full-scale input sinusoid is centered around $\frac{1}{2}$ of FS. For ease of computation, you can assume the transfer function has infinite number of steps.

Hint: $\sin^3 \alpha = \frac{3}{4} \sin \alpha - \frac{1}{4} \sin 3\alpha$

3. Since this is the spectrum for a real ADC with both quantization noise and circuit generated noise. Compute the approximate noise contribution by circuit in terms of ADC LSB.
4. Find the ENOB for this ADC.

