EE240C: Analog-Digital Interface Integrated Circuits **2019**

Homework #1

(due 9/13/2019; submit through bCourses)

Instructor: Johan Vanderhaegen (jpv@berkeley.edu)

Problem 1. Aliasing

A sinusoidal signal with a frequency of 4 MHz and with second and third order harmonics is sampled by a 6 MS/s system.

a) Draw the resulting spectrum. What happens to each of the distortion components ?

b) What is the minimum sampling frequency that avoids aliasing ?

Problem 2. Reconstruction

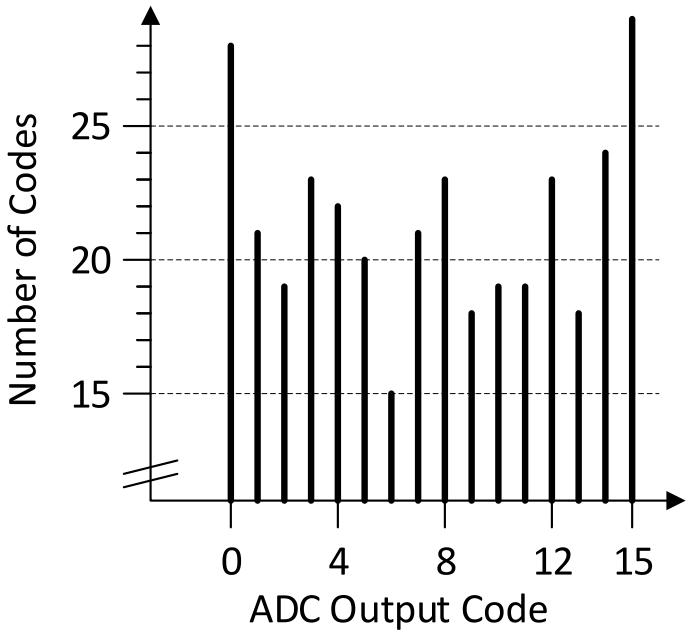
A discrete-time signal with a sample rate of $f_s = 1\,\text{MHz}$ is converted to continuous-time using zero-order hold pulses.

a) Plot the frequency response corresponding to reconstruction using zero-order hold pulses for pulse widths of 250 ns, 500 ns, and 1 µs.

b) Plot the output spectrum up to 2 MHz when a discrete-time sine wave of 200 kHz is converted to continuous-time using a 1 µs zero-order hold pulse.

Problem 3. ADC DNL and INL

The graph below shows a histogram of the output codes obtained for a 4-bit ADC with a linear ramp input. Calculate the peak positive and negative DNL and INL in LSBs.



Problem 4. ADC DNL and INL

a) Consider a monotonic ADC with output codes $0, 1, 2, \ldots, M$. Show that

$$\mathrm{INL}(k) = \sum_{i=1}^{k-1} \mathrm{DNL}(i)$$

b) Using (a), verify that

$$\sum_{i=1}^{M-1} \mathrm{DNL}(i) = 0$$