Some signal-processing common chores to be implemented

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1 Motivation and documentation

For getting into these, you'll need a certain mastery of two Python packages: `numpy` and `matplotlib`. The best way to have a grasp of what they provide is to read the tutorials *Tentative Numpy Tutorial* and *Tentative Numpy Tutorial* and *PyPlot Tutorial* (both barely scratch 1% of the surface of these immense libraries).

You will need to implement the figures of merit you have studied in the Analog Devices document and other sources:

Static DNL, INL (by the histogram method)

Dynamic ENOB, SNR, SINAD, THD

A necessary step from this to work properly is to test your programs with artificial signals that will give results know beforehand (e.g., we make up a noisy sine with a well-defined SNR and use it to test the algorithms implemented). So some of these exercises aim at providing such kind of signal. Then, we go for the implementation of the true measures that we will apply to true data coming from the devices to characterize.

2 Artificial signals to provide

1. We basically need a function

   ```
   def pure_sine(amplitude, frequency, phase,
   sampling_rate, samples)
   ```

   returning an array (from now on, we'll refer to a `numpy` vector as such) that results from sampling

   $$A\sin(2\pi ft+\phi) \tag{1}$$

   at the given sampling rate.

2. In the same vein, you will provide a noise generator like

```
def noise(amplitude, samples)
```

that generates `samples` samples of random noise of given amplitude.

3. Combining both, it is easy to create

```
def noisy_sine(amplitude, frequency, phase,
sampling_rate, samples, SNR)
```

to make a sine wave with a prescribed SNR. Work out a numeric example to check that the vector returned is OK.

4. Create a small routine

```
def plot(arr)
```

that plots the contents of the array `arr`.

5. For DNL and INL computations, we will also need to implement a simple function like

```
def adc_transfer(v, frs, bits)
```

that will return the integer (digital) value corresponding to an ideal ADC with full-range scale and number of bits given, when fed with `v` volts input.

6. Plot adc_transfer for $v = 0..frs$.

7. Quiz: how would you modifiy in the simplest way possible the function above to produce a transfer function with given DNL and INL?

3 Implementation of static measures

4 Implementation of dynamic measures