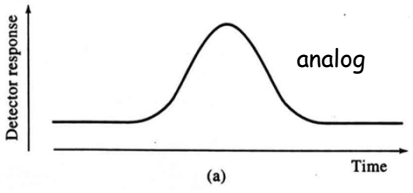
January 27, 2012

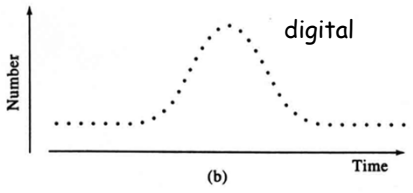
- Problem Set #1: Solutions Posted!
- Problem Set #2: To be posted by Sunday!
- Echem Readings: Posted!

1

More Signal Averaging

- **Signal must be digitized . . .** *How?*
- **Digitization frequency?**
  -Nyquist Theorem
- **Precision of digitization?**
  - how many bits?
  8-bit = 2^8 = *256* (0.4 %)
  12-bit = 2^{12} = *4096* (0.02 %)

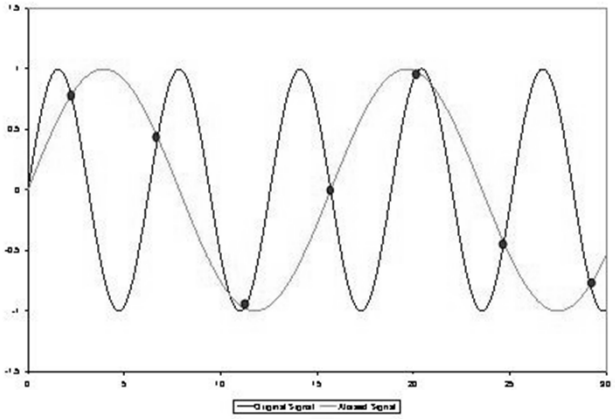




2

Aliasing

- What happens if sampling frequency is less than the Nyquist frequency?



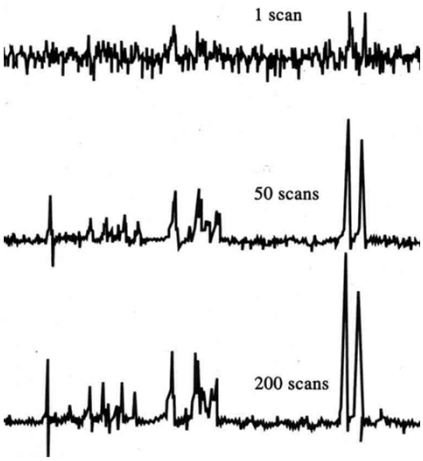
3

Signal Averaging a Spectrum

•Get same S/N enhancement:

-incr. with $n^{1/2}$

•Need good *synchronization* for each replicate scan



4

Digital Filtering

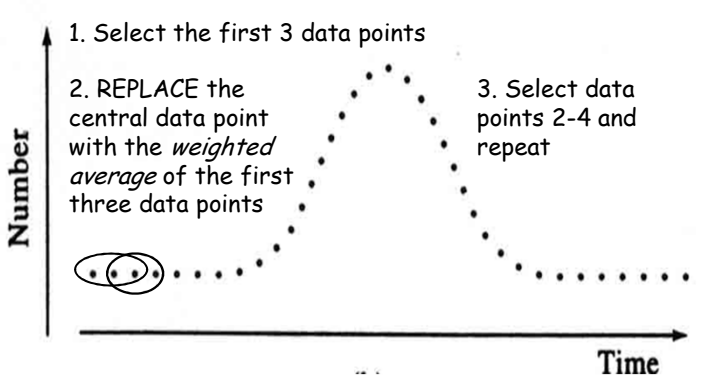
- **<u>Can manipulate *digitized signals* to improve S/N</u>**
  -can do this ***after*** data collection
  -don't need a repetitive signal

- **<u>Two methods we'll consider:</u>**
  -*Savitsky-Golay Smoothing* (time domain)
  -*Fourier Filtering* (frequency domain)

5

Savitsky-Golay Smoothing

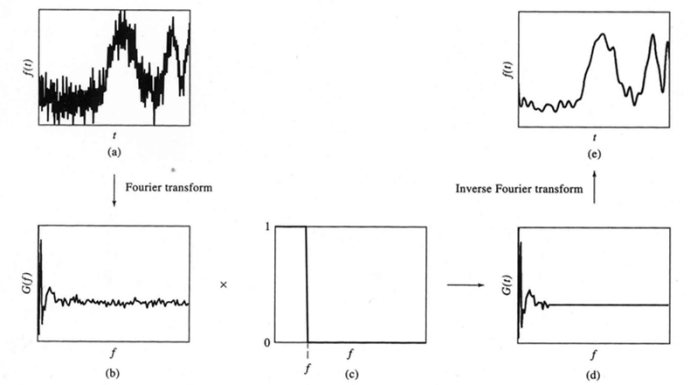
- A *weighted moving average* applied to a series of data. **<u>EXAMPLE:</u>** ***3-point smooth***



6

Fourier Filter/Smooth

- We would have greater *control* if we were to do this in the *frequency domain:*



7

Beware!

- It is easy to *smooth/filter* **signal** as well as noise
  -overlay original and processed waveforms
  -make sure that result is not ***distorted***

- Need high point density
  -trade-off between *resolution* and noise
  (high point density = greater Δf)

  -trade-off between *resolution* and **time**
  (lotsa data points = incr. storage and processing time)

Demos!

8