DC OFFSET

DC Offset

- Analog circuits often add DC offsets to signals which may be undesirable

- Suppose we want to detect a signal by summing magnitude over some period
- Example: detection circuit
  - No signal → 0
  - Signal → 1
  - No signal + DC bias → 1

$$\sum_{t=t_0}^{t_1} |x|$$

DC Offset

- Not usually a problem for high frequency signals
  - Filter out DC component with a high-pass filter
  - Analog or digital domain

DC Offset

- Can be a problem for signals with important components near DC, however
  - Still need a high-pass filter
  - Need a sharp frequency response to keep important low-frequency parts of signal
  - Digital processing may be best (or required)

DC Offset Cancellation Architectures

- A) Signal passes through high-pass filter
  - Filter must not distort signal
    - Phase response likely important
- B) Low pass filter estimates DC offset, which is then subtracted from the signal
  - Filter need only estimate DC magnitude
    - Phase response likely unimportant

DC Offset Estimation

- FIR filters
  - Have desirable characteristic of linear phase
  - Require higher-order filter typically
- IIR filters
  - Generally lower-order for same filtering requirements
- IIR filters can be best choice here since sharp-response low-pass magnitude-only output is typically required

DC Offset Estimation

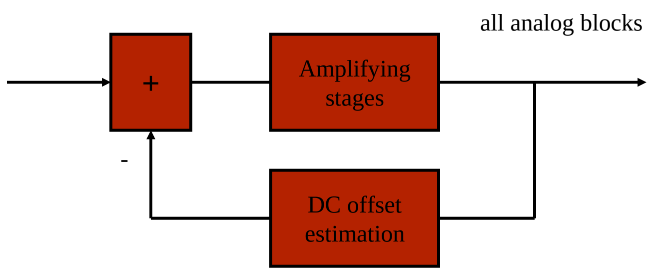
- Analog
  - Faster response
- Digital
  - Opportunities to use sophisticated algorithms. Can adapt estimator based on:
    - System mode (e.g., rapid changes or steady state)
    - Signal characteristics (e.g., make estimations more accurate)
    - Knowledge about circuit characteristics (e.g., self calibration)

DC Offset Cancellation Architectures

- 1) Feed-forward
  - DC offset estimator circuit receives the input signal
  - Generally faster responding
- 2) Feed-back
  - DC offset estimator circuit receives corrected signal
  - Generally more accurate as it can compensate for DC offsets introduced by the subtractor

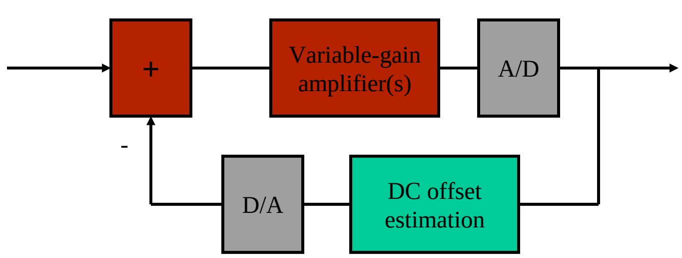
DC Offset Cancellation

- Many techniques to estimate DC offset of a varying signal
- Helpful to know characteristics of signal



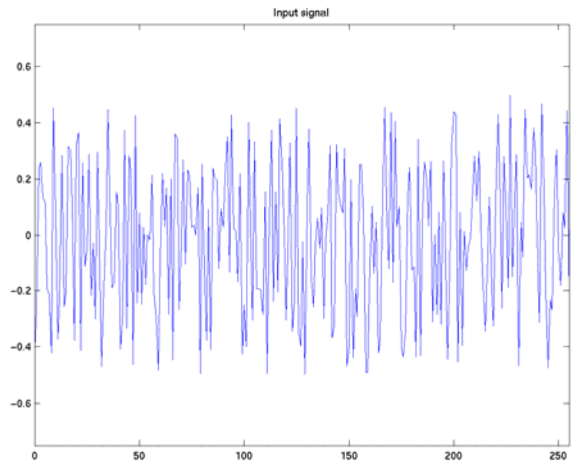
DC Offset Cancellation

- Can use more sophisticated DC offset algorithms with digital design
- Likely includes a low-pass filter



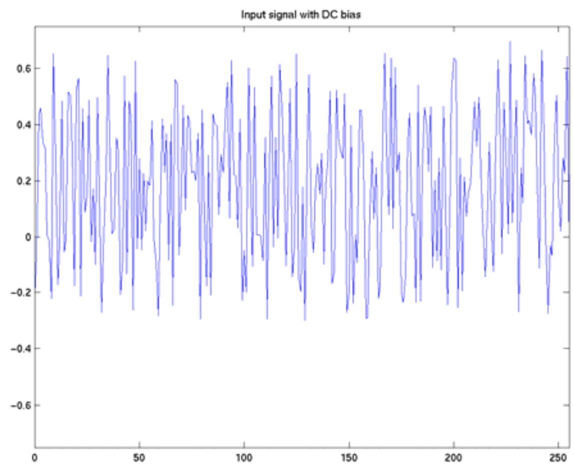
DC Offset

- Example input signal with no DC bias



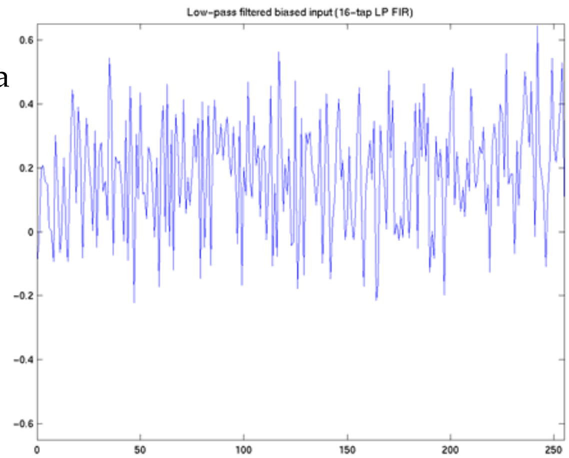
DC Offset

- Example input signal with positive DC bias



DC Offset Estimation

- Biased signal low-pass filtered with a *16-tap* FIR filter



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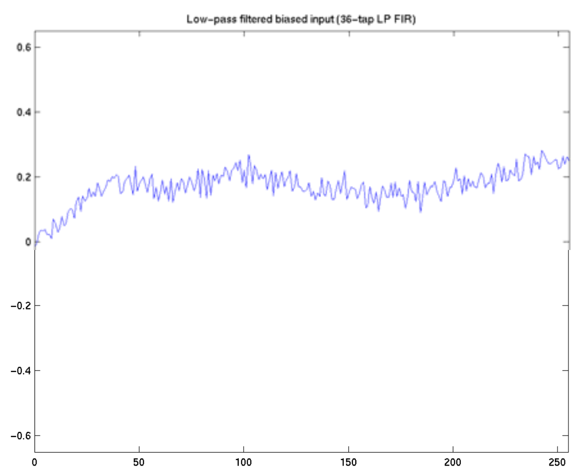
DC Offset Estimation

- Biased signal low-pass filtered with a *36-tap* FIR filter



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DC Offset Correction

- Corrected signal with little DC bias