Digital Signal Processing

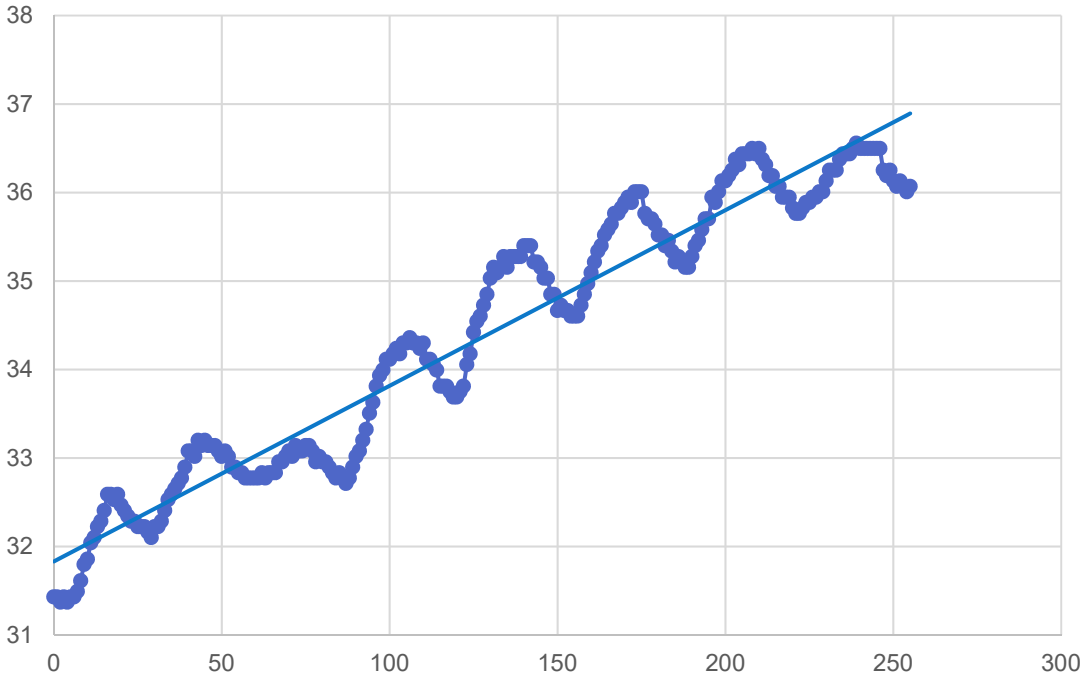
Lab 6 Introduction

Lab 6 Objectives

- To filter signals with different FIR filters on a microprocessor
- To demonstrate the proper choice of different datatypes for these filters
- **This is a 2-week lab**

Lab 6 Steps

- Create a model of real breathing data for use throughout the lab
  - Use your own data if appropriate or the file "Real_Breathing_Data.mat" on myCourses if in lab



Drift
Sinusoidal variation
Noise

Lab 6 Steps

- Investigate using Fixed Point Numbers, representing numbers with fractions
  - Use different scaling factors
  - E.g scale 33.45 by 100 to get 3345 integer value
  - Compare results for different scaling factors

Lab 6 Steps

- Experiment with several filter types and data type combinations:
  - Moving Average Filter (MAV)
  - Windowed SINC filter
    - Filter kernels are generated in the C-Code for you
- Investigate the differences in filters and the impact of datatypes

Moving Average Filters

- This filter computes the average of N samples
  Example: For an input $x[n]$ and N = 5

$$y[10] = \frac{x[6] + x[7] + x[8] + x[9] + x[10]}{5}$$

Moving Average Filters

- The impulse response or kernel of the filter with N samples is:

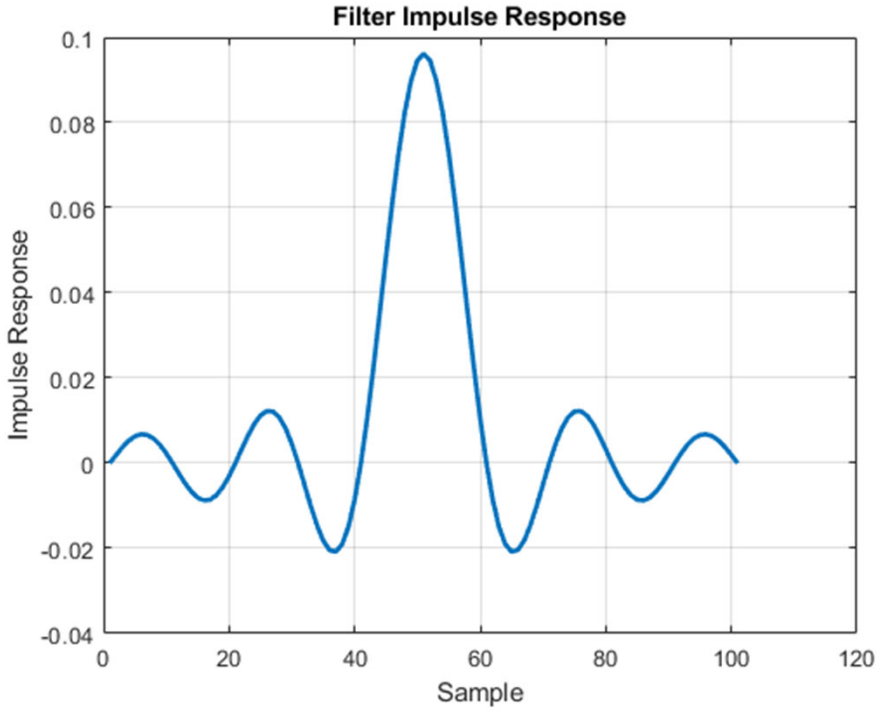
$$h[n] = [\frac{1}{N}, \frac{1}{N}, \frac{1}{N}, \ldots\ldots \frac{1}{N}]$$

- The moving average filter is good at smoothing signals with noise

- We'll investigate the impact of the changing length of the filter

Windowed SINC Filter

- The filter has an impulse response as shown below



- It can provide a sharper response than a MAV filter

Convolution

- Both filters can be implemented using convolution

- The code will compute the convolution sum for each point entering the filter

Lab 6 – FIR Filtering

Backup – Recall from Class

Representing Fractions with Fixed Point Numbers

- An INT can represent integers from -32768 to 32767
  - How can we represent a fraction?
  - What if we scale the fraction, then truncate to an integer?

Representing Fractions with Fixed Point Numbers

- Example: Represent the value 0.34789 using fixed point
  - If we just cast it as an INT it becomes 0
- If we first multiply by 10,000 then cast as an INT it becomes 3478
- Use LONG for even more resolution

What to Expect in Lab

- Filter the breathing signal with a moving average filter and an FIR filter
  - Using various datatypes for the impulse response
- Learn how to scale fixed point numbers to represent floating point values
- Experiment and determine execution times for different operations and data types