Digital Signal Processing

Lab 3 Introduction

Lab Breakdown

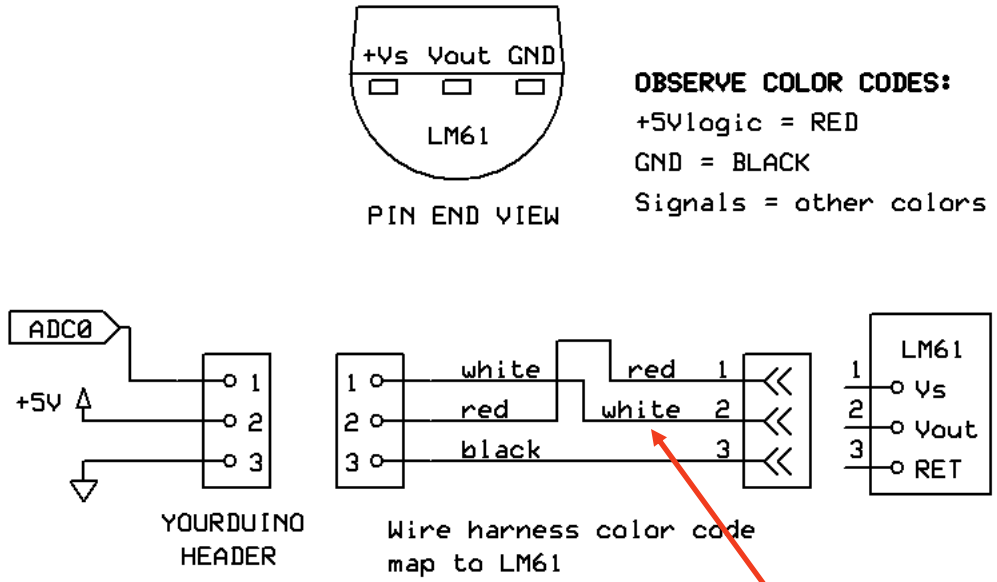
- Integrate the LM61 temperature sensor hardware with the Arduino hardware
  - Take some initial data samples
- Add an interrupt to take samples at known sample times
- Add code to control the start timing and collect a fixed number of samples

Lab Breakdown

- Interface the Arduino with MATLAB to collect and analyze data
- Add code to compute running statistics (mean and variance) from generated data

LM61 Hardware Interface

- It is critical that you wire the temperature sensor correctly!
  - Follow the schematic carefully (not the colors)



Carefully note the pinout!

The pins are shown coming out towards you

Note the wiring

Copying Code from the Procedure

- In the Lab Procedure, there are text boxes that contain Arduino code

```
//  AnalogReadSerial: public domain code
//  Reads analog input on pin 0, prints to console.

void setup() // runs once when you press reset
{
  Serial.begin(9600);
}

void loop() // runs over and over forever
{
  int sensorValue = analogRead(A0);
  Serial.println(sensorValue);
  delay(1); // delay in between reads for stability
}
```

- Mouse in the box, select all (CTRL-A) and copy. Then paste into the Arduino IDE.

Reading Data using MATLAB

- MATLAB will read data from the Arduino serial port interface

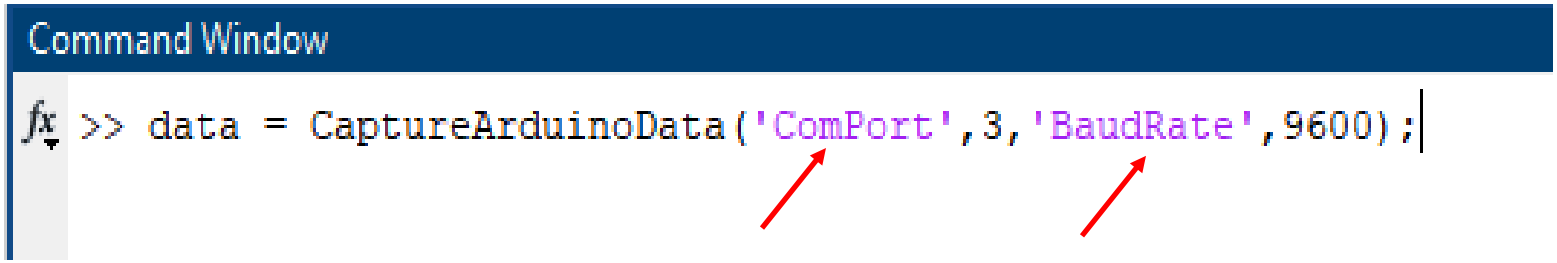
- Copy the following three ".m-files" from myCourses to your working directory (MATLAB Tools\Arduino Interface)
  - ArduinoSerial.m
  - CaptureArduinoData.m
  - ActivePlot.m

Reading Data using MATLAB

- Arduino and MATLAB perform a “handshake” at the beginning of operation
  - Arduino sends “%Arduino Ready”
  - MATLAB returns with “g”
  - Program execution begins

MATLAB Commands

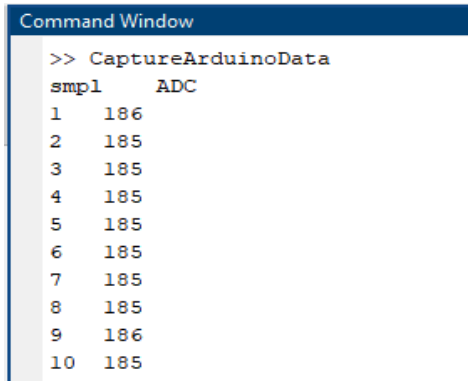
- Use the Command Window (not Live Editor)
- The main routine is “CaptureArduinoData”
- MATLAB can take arguments to set the Com port and the data rate as Name , Value pairs



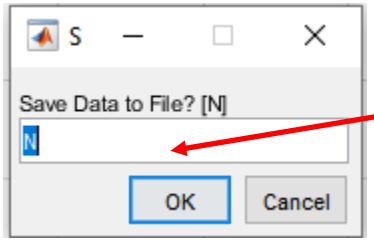
Change the ComPort and baud rate accordingly

MATLAB Commands

- Data will be echoed in the command window



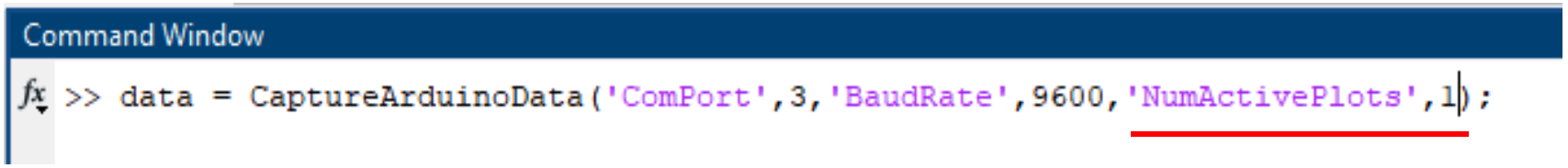
- After data collection is complete, you will be prompted to save the data in a .mat file



DO NOT enter a file name here, just Y or N

MATLAB Commands

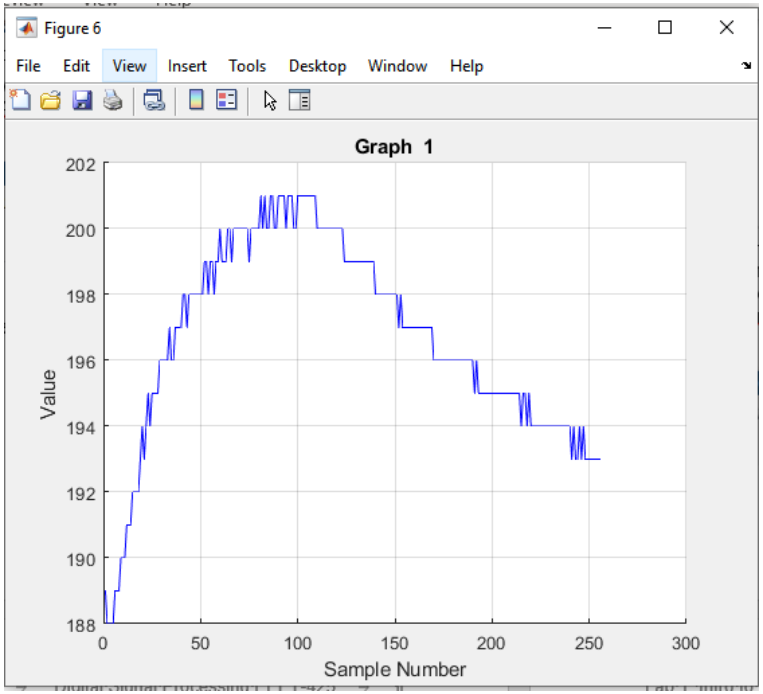
- To plot data simultaneously (while reading data) use the active plot options



- Use 'NumActivePlots' property. Must have N+1 data values. All data is plotted against the first data value (e.g. sample number).

MATLAB Commands

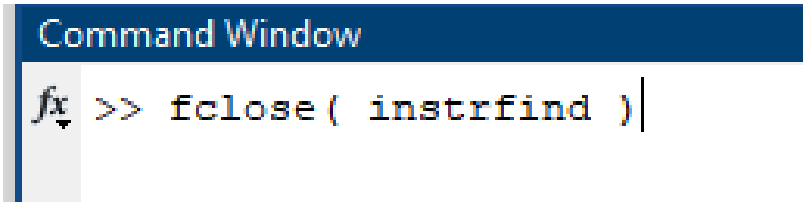
- Each graph will draw in “real time” so that you can actively see your sample data



If you have a Serial Port Conflict

- Arduino and MATLAB share the serial port
  - Arduino uses it for uploading the sketch
  - Both use it to share data

- Sometimes there is a conflict
  - MATLAB hasn't released the port (e.g. program terminated early via CTRL-C)
  - In MATLAB command window use to release serial port



Computing Running Statistics

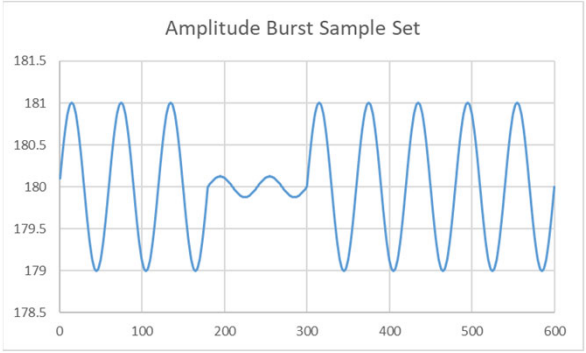
- The last section of the lab asks you to write some code to compute running statistics
  - Numerically robust approach (see the supplemental resources)
  - Data is generated within Arduino C-code
  - Compute and display for both the amplitude burst and the frequency burst data

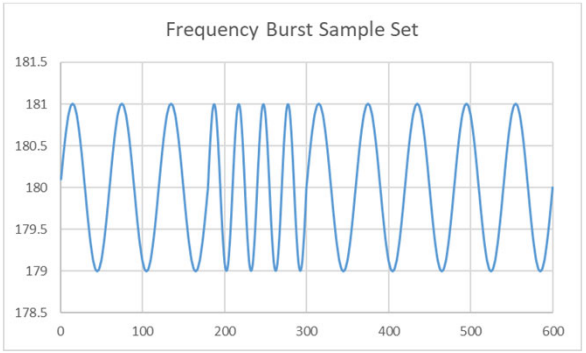
Computing Running Statistics

```
//*****************************************************************************
float simSample(void)
{
  // Simulate sensor for stats calculation development
  float simSmpl, simAmp = 1.0, simT = 60;

  //simAmp = ((numSamples > 180) && (numSamples < 300)) ? 0.125 : 1.0; // burst amplitude
  //simT = ((numSamples > 180) && (numSamples < 300)) ? 30.0 : 60.0; // burst frequency
  simSmpl = 180.0 + simAmp*sin((numSamples/simT)*TWO_PI); // fixed amplitude, frequency

  return simSmpl;
}
```

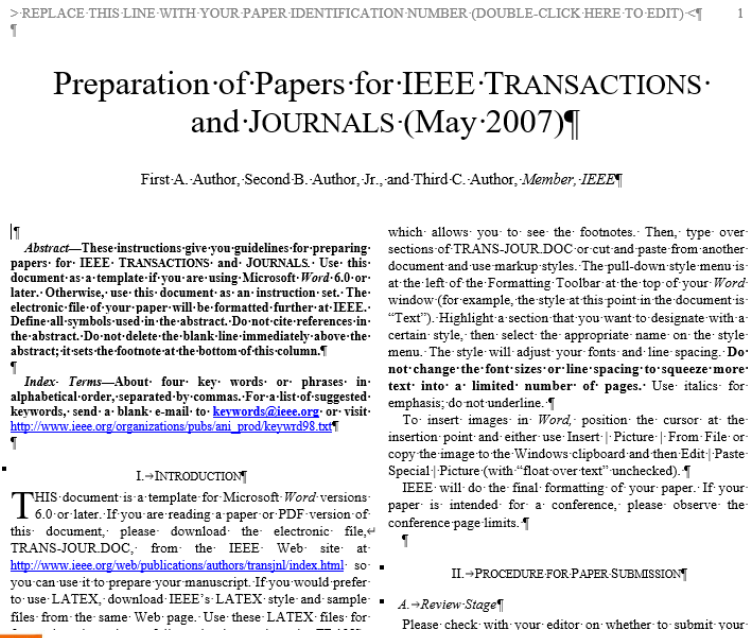




- By “comment selecting” the simAmp or simT equations, you can select either input

Lab Report

- This lab report is to be submitted using the IEEE format.
  - Use the template on myCourses



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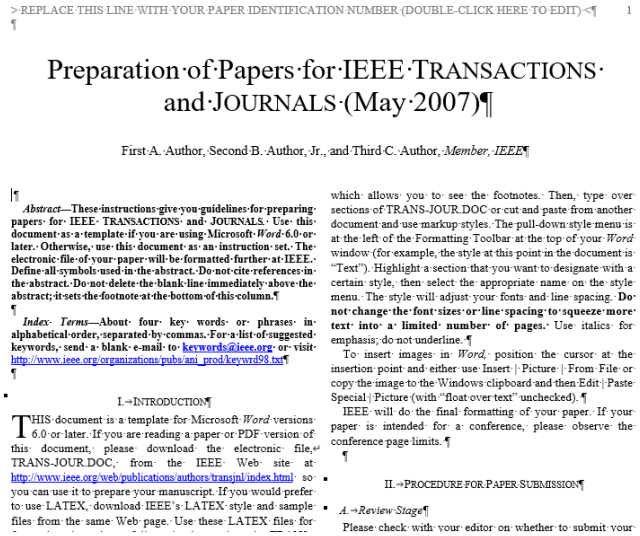

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