

### Homework #3: PWM and Filtering

Due Monday

1. Look up the spec sheet for the RGB LED and connect the R, G, and B LEDs to different PWM pins and write a sketch to change the color of the LED to all of the  $2^{24}$  possible colors.
2. Write a sketch making your Arduino AnalogWrite a steadily increasing voltage, then a steadily decreasing voltage, etc., repeating to essentially generate a triangle wave voltage at a frequency of  $\sim 10$  Hz.
  - a. Plot the raw PWM signal in serial plotter
  - b. Construct a low pass filter with a 3dB point of 1000 Hz; Input the PWM out into this filter; Analog read the filtered signal and plot it
  - c. Repeat b with a low pass filter with a 3dB point of 10 Hz
  - d. Repeat b with a low pass filter with a 3dB point of 1 Hz
  - e. Repeat this for a sine wave generated with AnalogWrite.
3. Make a distance sensor using LEDs and phototransistor
  - a. Relate the LED-phototransistor distance to measured signal for the red and green LEDs by taking data and making a graph
  - b. Does it make a difference if you do it in the dark?
  - c. Is there a difference between red and green light in the sensitivity of the phototransistor?
    - i. Make sure if you are trying to compare them that you control for the luminosity/brightness of each LED.
  - d. Is there an angular orientation dependence for the LED and phototransistor?
  - e. Does this work for scattered light? (i.e. have the LED and detector facing outward and in the same direction, and block any direct transmission of light from the LED to the detector.) Can you detect objects that are close by through sensing of light scattering off of them? Can you get the range of these objects from the detector?