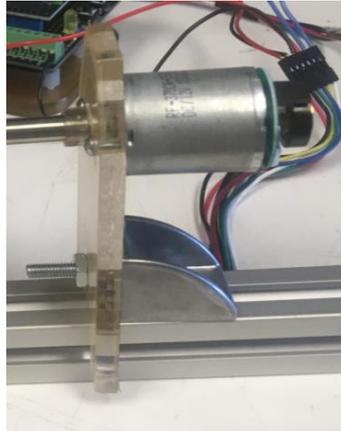


Homework 2

Measurement Motor Performance Without Added Inertia or Friction

Motor Mounting

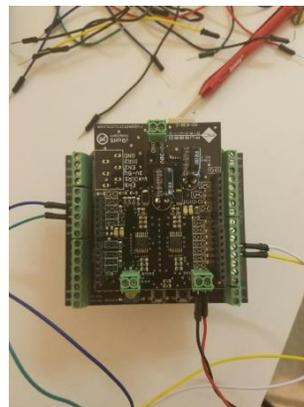
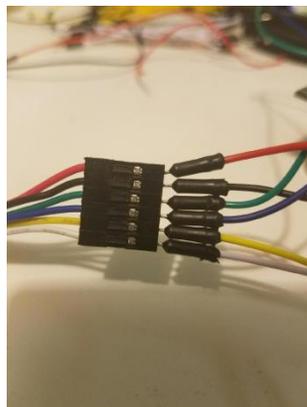
Mount the motor as shown in the picture.



Motor Wiring

As listed and shown in the table and pictures, respectively, below, connect the motor to the power supply and Arduino Uno.

Color	Function
Red	motor power (connects to one motor terminal)
Black	motor power (connects to the other motor terminal)
Green	encoder GND
Blue	encoder Vcc (3.5 – 20 V)
Yellow	encoder A output
White	encoder B output



Sample Arduino Code

The following code reads from the motor's encoder and outputs time and "counts".

```

/*
 * MAE 156A - Measuring No-Load Speed
 * Motor: Pololu Motor 3260
 * Spec No-Load Speed: 5600 RPM
 *
 * September 29th, 2016
 *
 */

#define motor_pwm 3           //define PWM pin number for motor pwm
#define motor_dir 12         //define digital pin number for motor direction

int encA = 2;                //define Encoder A channel pin

int encAnow = LOW;           //define current state of Encoder A
int encAprev = LOW;         //define previous state of Encoder A

unsigned long t, count;      //interrupt timing and counting variables

void setup() {
  Serial.begin(115200);      //serial output transmission rate (bps)
  pinMode(encA, INPUT);     //Encoder A on motor encoder
  pinMode(motor_dir, OUTPUT); //define Pin 12 for motor direction (HIGH or LOW)
  digitalWrite(motor_dir, HIGH); //set motor direction
  analogWrite(motor_pwm, 255); //set motor speed in duty cycle (0-255)
}

void loop() {

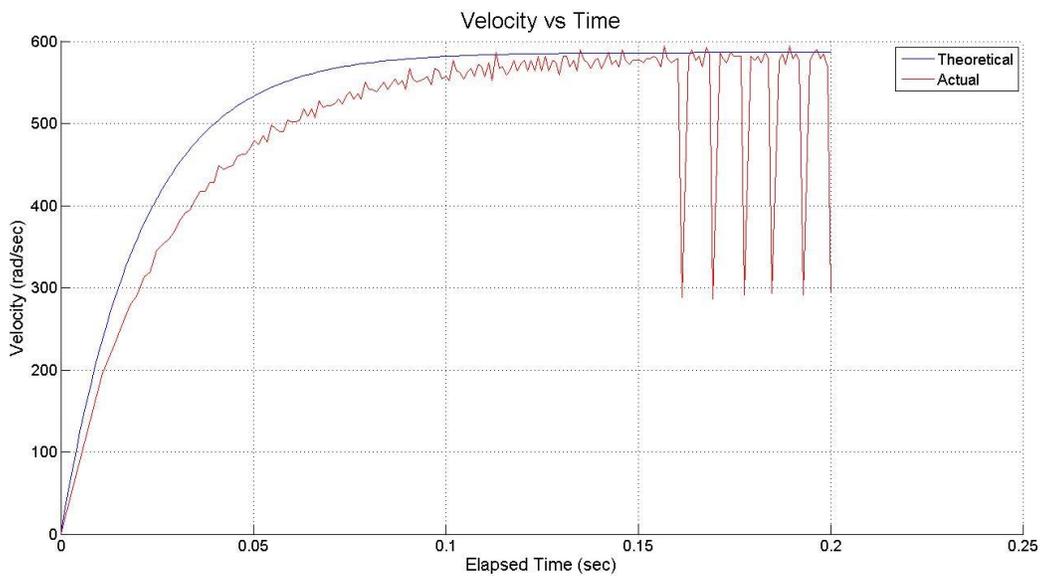
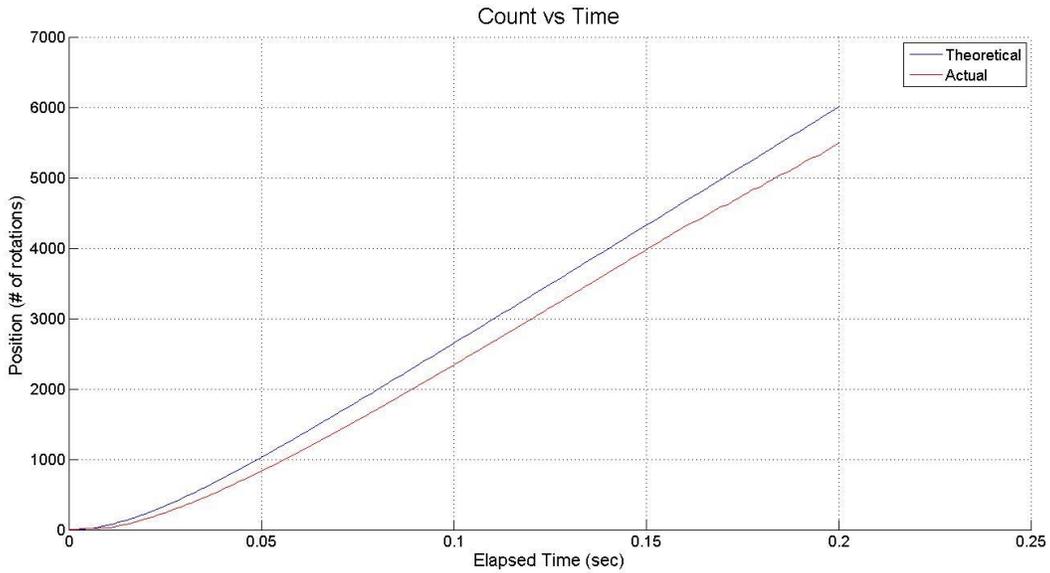
  encAnow = digitalRead(encA); //read the current state of Encoder A

  // Check if Encoder A is transitioning from 'LOW' to 'HIGH' State
  if ((encAprev == LOW) && (encAnow == HIGH)) {
    count++;                //increase the number of Encoder A count
    Serial.print(micros()); //time base for speed data
    Serial.print(",");      //data separator character
    Serial.println(count);  //counts for position and velocity calculation
  }

  encAprev = encAnow;      //set the previous Encoder A reading as same as the current reading
}

```

Comparison Plots



Discussion

1. What does the initial slope of the velocity curve represent? How does the simulation and experimental slopes match up? Discuss possible reasons for any differences and why one slope may be larger than the other.

The initial slope of the velocity curve represents the initial acceleration of the motor. The simulation and the experimental slopes do not match. This may be due to difference between theoretical and actual stall torque and motor inertial

2. What does the final value of the velocity curve represent? How does the simulation and experimental velocities match up? Discuss possible reasons for any differences and why one final velocity may be larger than the other.

The final value of the velocity curve represents the “no-load” speed of the motor. The simulation and the experimental values match closely.

3. Discuss the noise in the plots. Is there more noise in the position or velocity plot, and why?

Both curves have noise, but the velocity curve is noisier as we took first derivative of the position data in order to obtain the velocity curve. This process amplifies the noise, as shown in the velocity plot.

4. Are there any unusual phenomena in the data, and what might be the reasons for this?

After reaching the no-load speed, the velocity curve shows large “dip”, where the velocity is halved. This is due to skipped encoder counts as the serial output cannot keep up with the encoder counting at no-load speed.