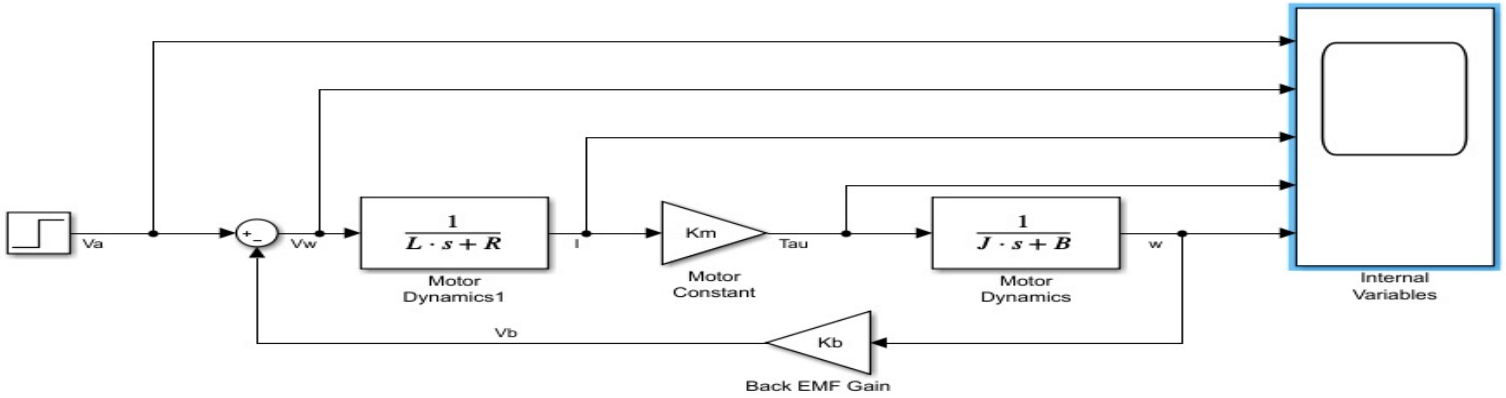
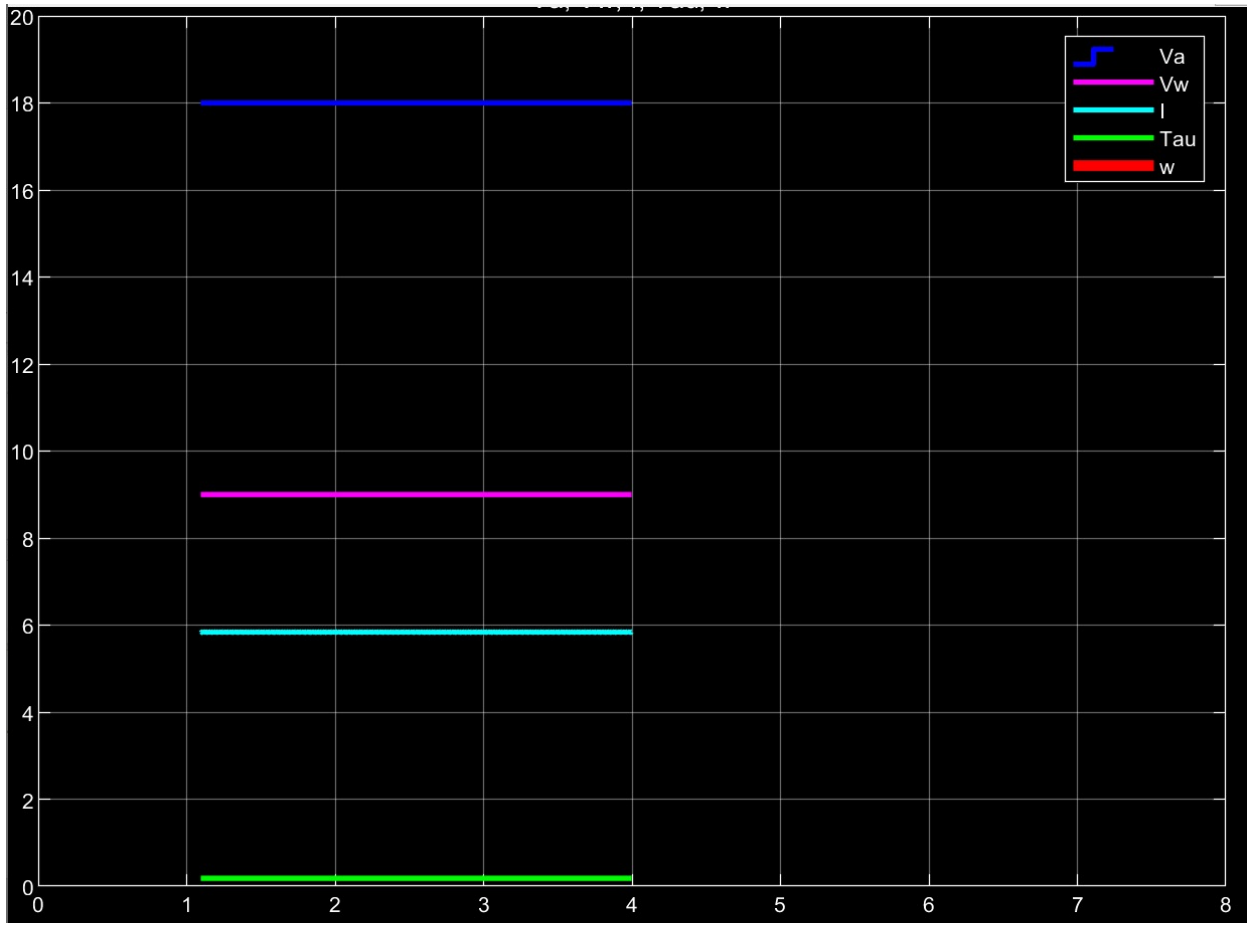
Active Pendulum

February 2021

Step1: Motor




```
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
% Initializes variables for the Simulink model of an electric motor %
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%

% Start with a clean slate
clear all;

% Motor parameters
% Electrical
R  = 1.54;                      % Armature resistance(ohm)
L  = 0.000268;                  % Armature inductance(H)

% Mechanical
J  = 1.94*(10^-7);              % Armature inertia kgm^2
B  = (1/15300)*0.1047198;       % Armature damping Nm/(rad/s)

% Bridge
Km = 0.031;                     % Motor constant(Nm/A)
Kb = (1/308)*0.1047198;         % Back-EMF constant V/(rad/s)

% Display some results
G  = tf(Km, [L*J (L*B + R*J) R*B]);
H  = tf(Kb, 1);
TF = feedback(G,H)
```



Step2: Arduino

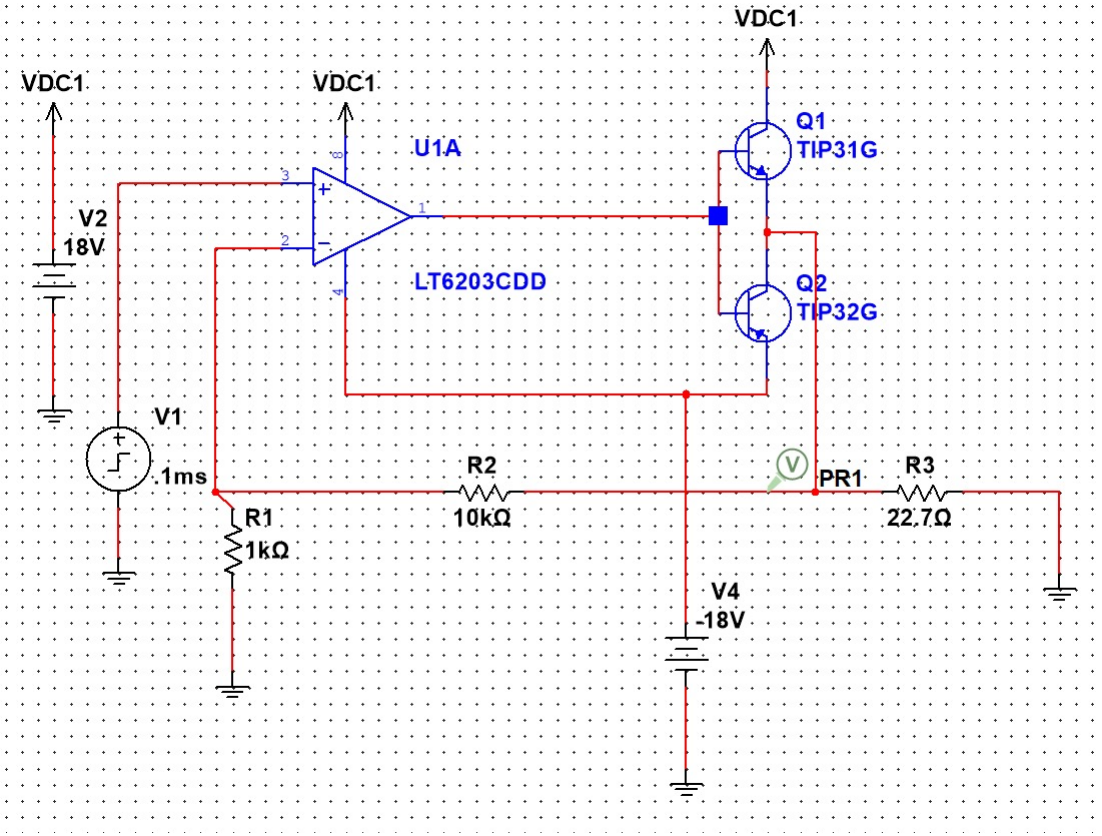
ISR rate = 8*1000/(202/16MHz)=633.6636637

202/16MHz

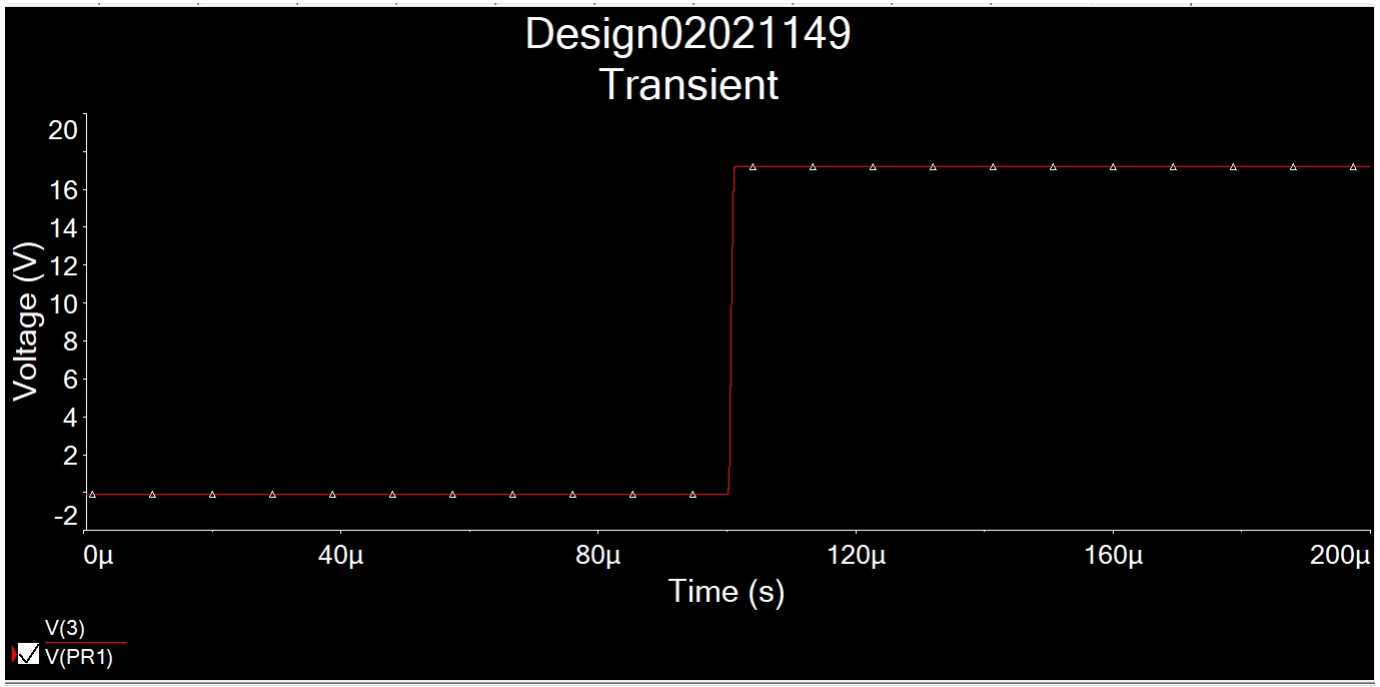
16MHz*1000/202 = 16*1000/202= 79.2079207921

```
int sensorPin = A0;     // select the input pin for the potentiometer, 4
int ledPinIn = 13;      // select the pin for the LED, 4
int sensorValue = 0;    // variable to store the value coming from the sensor, 4
int incomingByte = 0;   // for incoming serial data, 4
int ledPinOut = 9;      // Motor connected to digital pin 9, 4
int valueOut = 3;       // variable to store the command for motor, 4

void setup() {                  // 12
  // put your setup code here, to run once:
  pinMode(ledPinIn, OUTPUT);  // declare the ledPin as an OUTPUT, 6
  Serial.begin(9600);         // opens serial port, sets data rate to 9600 bps, 6
  pinMode(ledPinOut, OUTPUT); // set the pin as output, 6
}

void loop() {                           // 10
  // put your main code here, to run repeatedly:
  sensorValue = analogRead(sensorPin);  // read the value from the sensor, 4 + 8
  digitalWrite(ledPinIn, HIGH);         // turn the ledPinIn on, 9
  delay(sensorValue);                   // stop the program for <sensorValue>ms, 3
  digitalWrite(ledPinIn, LOW);          // turn the ledPinIn off, 9
  delay(sensorValue);                   // stop the program for <sensorValue>ms, 3

  if (Serial.available() > 0){          // send data only when you received data, 11 + 18 + 4
    incomingByte = Serial.read();       // read the incoming byte, 4 + 8

    if (incomingByte == sensorValue){   // compare with the wanted position, 11 + 18 + 4
      valueOut = 1;                     // if same, send 1 to motor, 4
    } else {                            // 10
      valueOut = 0;                     // if not same, send 0 to motor, 4
    }

    analogWrite(ledPinOut, valueOut);   // send the value to output pin, which connected to motor, 6
  }                                     // total = 202
}
```

Step3:Multisim and Ultiboard

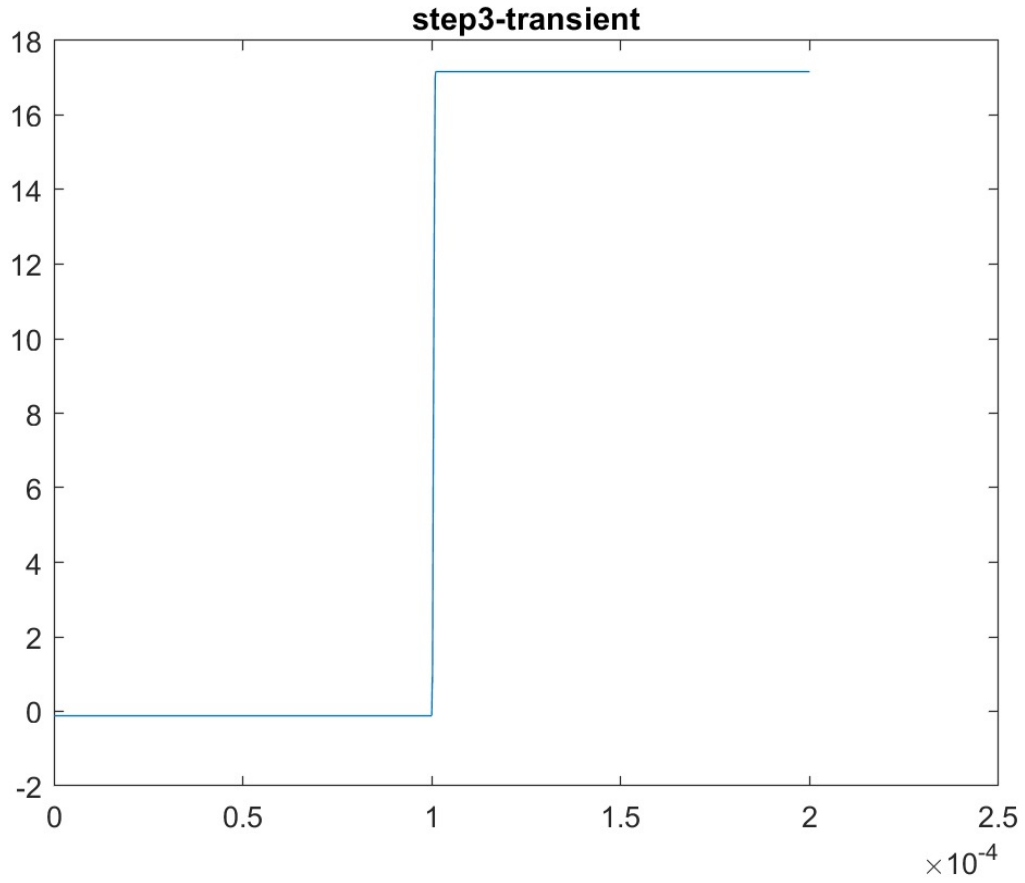


Multisim - circuit

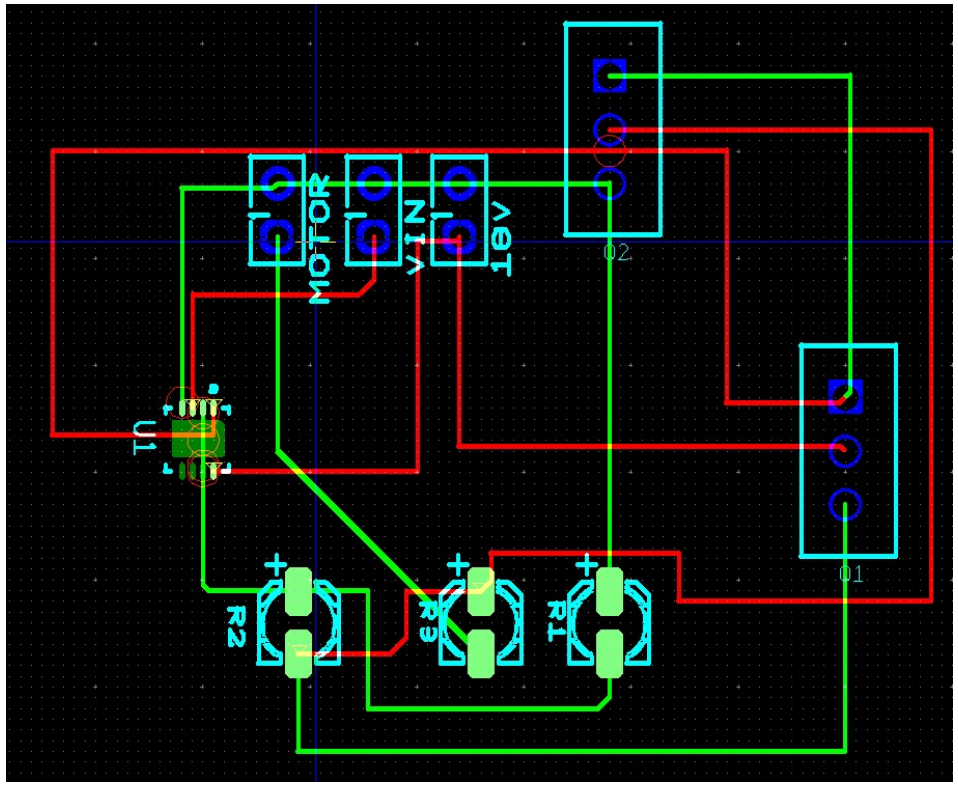


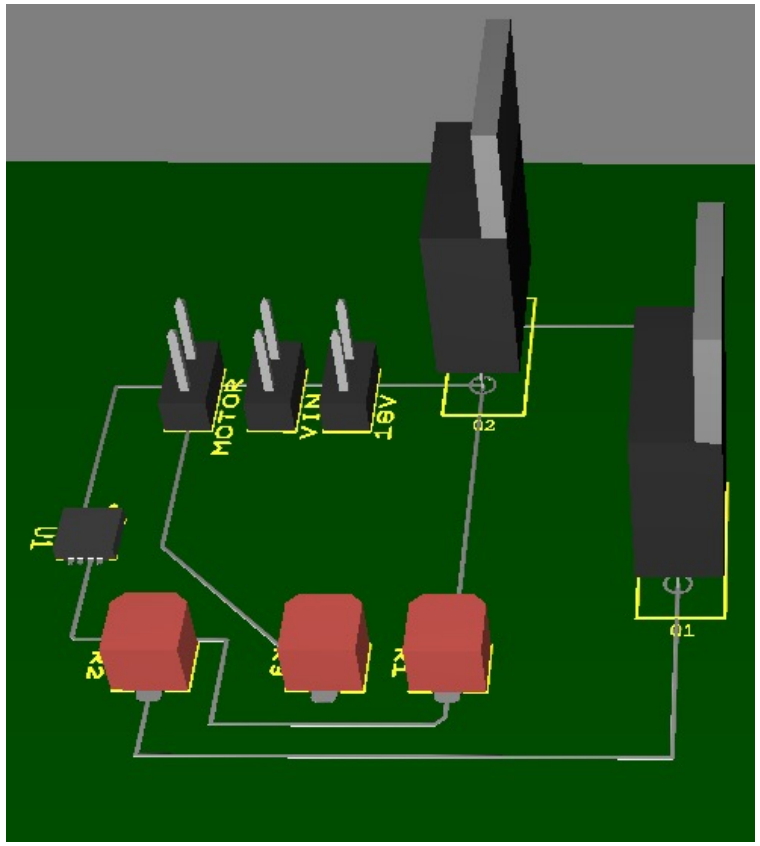
Multisim – transient graph

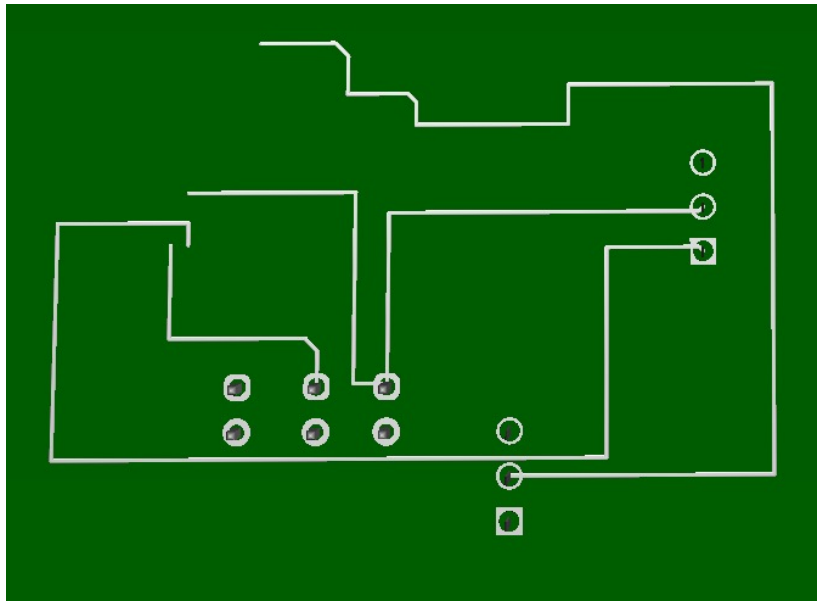
Step3-Multisim and Ultiboard



Step3:Multisim and Ultiboard





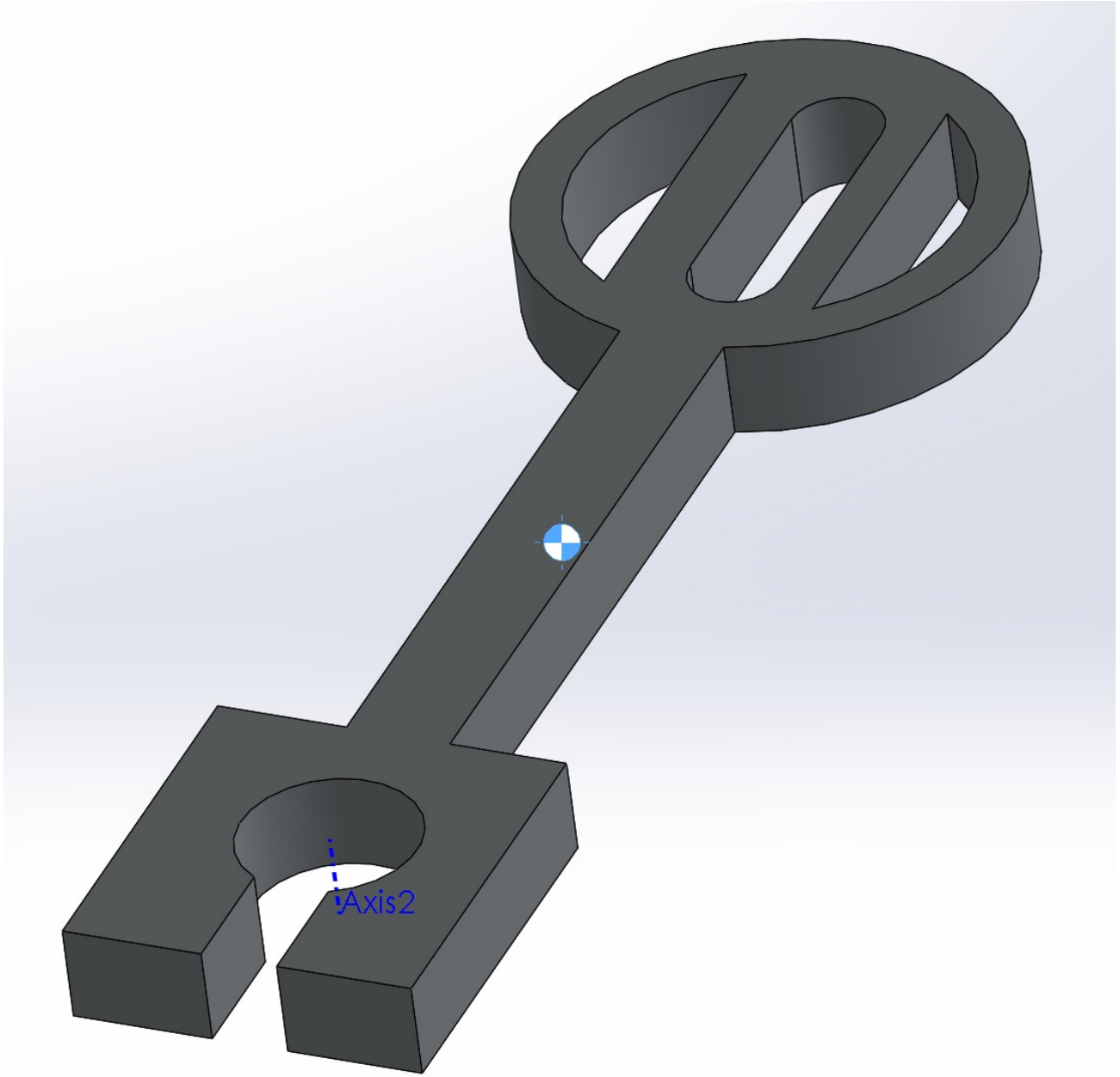


Step4:Solidwork

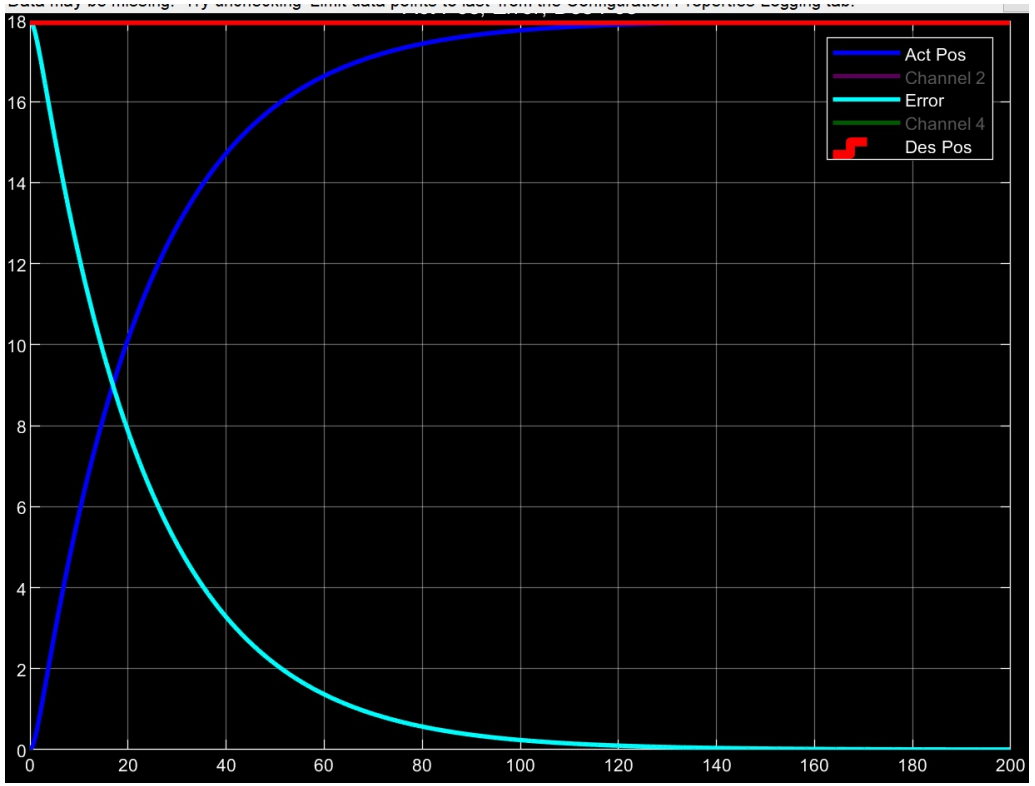
Torque

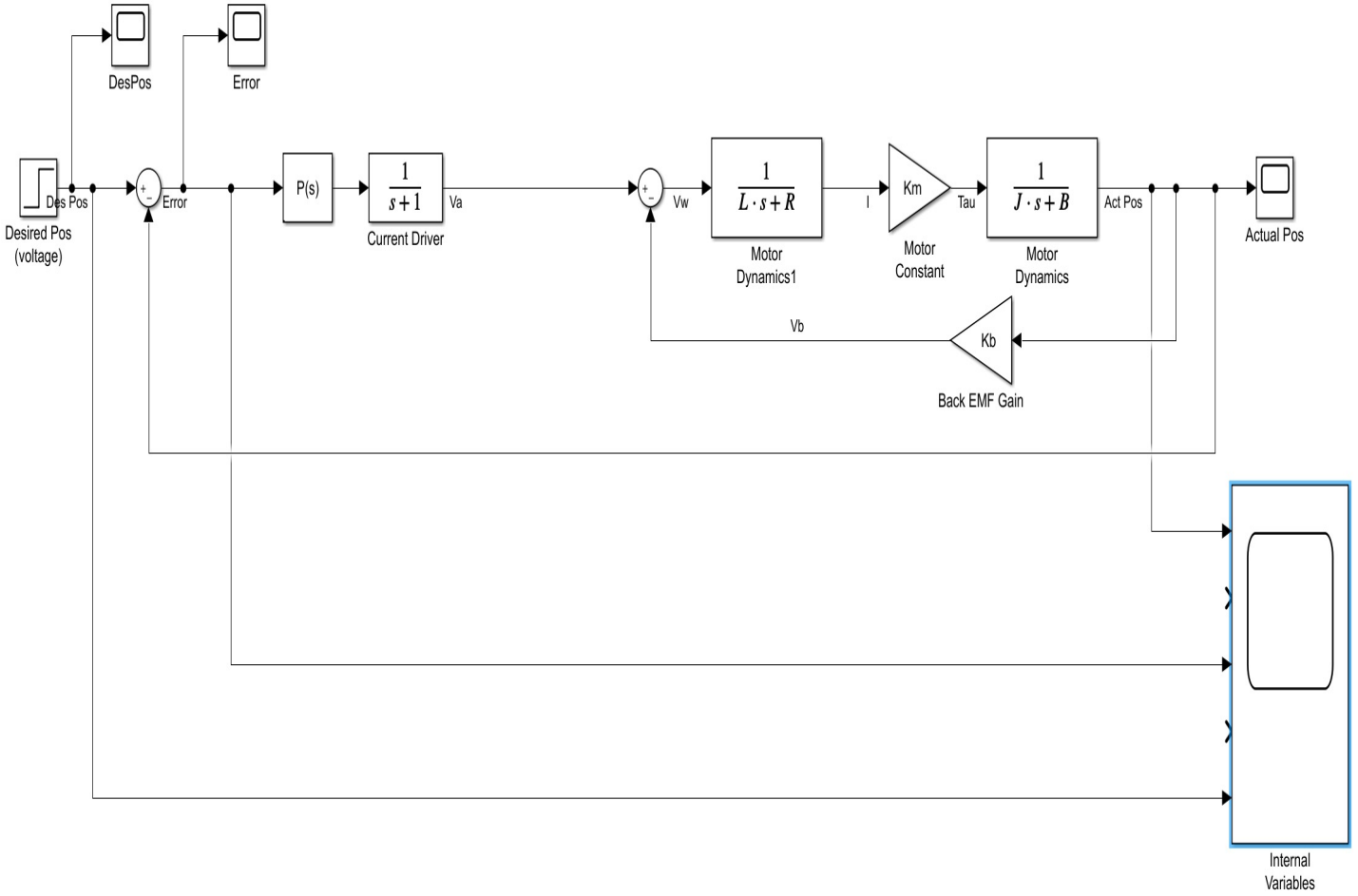
= 6.20079kg * 9.8N/kg * 15*0.001 * cos(180)

= 0.9115 Nm



Step5:Simulink





Step6:SimulationX