Appendix A

Arduino DUE software

#include <PID\_v1.h>

const int quad\_A = 2;

const int quad\_B = 13;

const unsigned int mask\_quad\_A = digitalPinToBitMask(quad\_A);

const unsigned int mask\_quad\_B = digitalPinToBitMask(quad\_B);

double Setpoint=0, Input=0, Output=0;

double ku=0.35;

double tu=0.3;

int deadband = 35, Value =0;

double Kp=0.6\*ku, Ki=tu/2, Kd=tu/8;

PID myPID(&Input, &Output, &Setpoint, Kp, Ki, Kd, DIRECT);

String C, D;

void setup() {

// activate peripheral functions for quad pins

REG\_PIOB\_PDR = mask\_quad\_A;

REG\_PIOB\_ABSR |= mask\_quad\_A;

REG\_PIOB\_PDR = mask\_quad\_B;

REG\_PIOB\_ABSR |= mask\_quad\_B;

REG\_PMC\_PCER0 = (1<<27);

REG\_TC0\_CMR0 = 5;

REG\_TC0\_BMR = (1<<9)|(1<<8)|(1<<12);

REG\_TC0\_CCR0 = 5;

Serial.begin(115200);

Serial1.begin(38400);

pinMode(4,OUTPUT), (5,OUTPUT) ;

digitalWrite(4,LOW), (5,LOW) ;

myPID.SetOutputLimits(-(255-deadband), (255-deadband));

myPID.SetControllerDirection(DIRECT);

myPID.SetMode(AUTOMATIC);

}

void loop() {

if (Serial1.available() > 2) {

digitalWrite(4,HIGH);

digitalWrite(5,HIGH);

C = Serial1.readString();

if (C.substring(0,2) == "x=") {

C = C.substring(2,8);

Input = C.toInt();

Serial1.println(Input);}

}

Value = REG\_TC0\_CV0;

Setpoint = Value;

if (abs(Input - Setpoint) > 200) {deadband = 30;}

else {deadband = 35;}

myPID.Compute();

Serial.print (Setpoint);

Serial.print (" ");

Serial.print (Input - Setpoint);

Serial.print (" ");

Serial.print (Output);

Serial.print (" ");

if (Input - Setpoint == 0) {

digitalWrite(5,LOW);

digitalWrite(4,LOW);}

else {SetTorque(Output);}

Serial.println (" ");

}

void SetTorque(int T){

if (T > 0) {

T=T+deadband;

if (T > 255) {T = 255;}

digitalWrite(5,HIGH);

analogWrite(4,255 - T);

Serial.print (255 -T);

}

if (T < 0) {

T=(-T)+deadband; // reverse T

if (T > 255) {T = 255;}

digitalWrite(4,HIGH);

analogWrite(5,255 - T);

Serial.print (255 -T);

}

}