COMPUTER CONTROL OF MAGNUS EFFECT AIRFOIL  
ME 670

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# EXPERIMENTAL SETUP

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# CODE

//MOTOR CONTROL PROGRAM FOR ME 670 FINAL PROJECT

//This program allows a user to input a motor power level with the serial monitor, and have the motor spin to that power

//This version allows for proportional control

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//Developed on Arduino UNO

//For: Thunderbird 18 ESC; MEGA Motor ACn 16/15/8

//This program is for temperamental electronic speed controllers that require the 50 Hz PWM signal given by hobby receivers (1-2 ms on, 18-19 ms off)

//A pulse width of 2 ms on represents full throttle, 1 ms

#include <**Servo**.h>

#include <stdint.h>

const uint8\_t SIGNAL = 3; //this is the pin on the Arduino producing the signal for the ESC (does not need to be a PWM output pin)

const uint32\_t BAUD = 9600; //rate of communication with the arduino

const uint8\_t RESPONSETUNING = 4; //this is a proportional control parameter, it adjusts how fast the motor will reach the desired speed. Higher values decrease the response speed

const uint16\_t TIMETUNING = 200; //this is another proportional control parameter, it adjusts how long the motor spins at a certain value during speed transient

uint16\_t current = 1000; //the current pulse value - zero throttle to arm the ESC - this value must be 1000 microseconds during start up, but is changed later as the program runs when the variable is used for proportional control

Servo THUNDERBIRD; //Creating a servo object for the thunderbird 18 ESC (it is controlled the same way a servo would be)

void setup()

{

THUNDERBIRD.attach(SIGNAL); //this binds the servo object to a specific pin, the servo object is used instead of a pin number from here on out

**Serial**.begin(BAUD); //start a serial communication - make sure that the serial monitor is set to a BAUD of 9600, and no line endings!

**Serial**.println("Enter a motor speed (percentage of full throttle):");

THUNDERBIRD.writeMicroseconds(current); //initializing the ESC - it won't take any commands until it sees zero throttle (1000 microseconds). This is done in setup so the user doesn't have to do it in the terminal.

}

void loop()

{

while (**Serial**.available())

{

uint16\_t target = **Serial**.parseInt(); //whatever number the user just typed in is the new motor pulse speed IN PERCENT!

**Serial**.print("New Speed: ");

**Serial**.print(target); //displaying the percentage value to the user before it is converted to a pulse width for the ESC to understand

**Serial**.print("%");

**Serial**.print('\n'); //new line for the next output

target = (target\*10)+1000; //converting percentage to a pulse width for use with theThunderbird 18 ESC

int16\_t difference = target-current; //finding the difference between the target speed (pulse length) and the current speed (pulse length) - the units are pulse width difference in microseconds

while (difference != 0)

{

int16\_t response = difference/RESPONSETUNING; //response can be positive or negative, and uses a tuning factor to generate a value to be added or subtracted from the current pulse width to get closer to the target value

current = current+response; //updating the new speed of the motor by factoring in the response modifier

THUNDERBIRD.writeMicroseconds(current);

difference = target-current;

//Serial.println(difference); //the difference between the current speed setting and target speed setting can be displayed if desired

delay(TIMETUNING);

if ((difference <= 5) && (difference >= -5)) //if the difference is small enough then just ignore it and go straight to the target value

{

THUNDERBIRD.writeMicroseconds(target); //go straight to the target pulse width before terminating the while loop

current = target;

difference = 0; //terminates the while loop and resets the difference variable for further use

}

}

}

}