Thrust Source Elevation Control

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Abstract

Altitude-control of an aerodynamic entity which is objected for airlift is essentially governed by a tuned Plant-controller. PID control technique is being implemented in controlling the aerodynamic entity. Aerodynamic entity will be Brushless DC motor. Initially, the comparison between coreless DC motor and brushless DC motor was made and Coreless DC had an edge over the Brushless DC motor for the project. But further we changed it to BLDC. The project is initially focused on traditionally tuning the Plant which is linearly modeled in Discrete-time Domain. Performed an experiment to find the linear range of the ultrasonic sensor (HCSR-04). Constructed setup with plywood and guitar strings, a performed experiment of speed control. Vertical position associated with propulsion plant is sensed and reported by the ultrasonic sensor. Reference-input and Controlled-output signals are digitally acquired via Microcontroller for Set-point based Altitude-control. Further to this Arduino Uno will be used as our microcontroller, and it will be interfaced with MATLAB. The parameters of PID control will be deducted using MATLAB. Therefore, data is numerically computed. Robustness and Optimal Control are scarcely discussed for lateral continuum.

Keywords: MATLAB, PID, CLDC Motor, HCSR-04, Potential Divider etc.

1. Introduction

Aerodynamic entity will be Brushless DC motor. Initially, the comparison between coreless DC motor and brushless DC motor was made and Coreless DC had an edge over the Brushless DC motor for the project. But further we changed it to BLDC. The project is initially focused on traditionally tuning the Plant which is linearly modeled in Discrete-time Domain. Performed an experiment to find the linear range of the ultrasonic sensor (HCSR-04).
The picture of the project is mentioned below :

2. Principle Of Brush Less Motor

The basic principles for the brushed DC motor and for brushless DC motor are same i.e., internal shaft position feedback. **Brushless DC motor** has only two basic parts: rotor and the stator. The rotor is the rotating part and has rotor magnets whereas stator is the stationary part and contains stator windings. In BLDC permanent magnets are attached in the rotor and move the electromagnets to the stator.

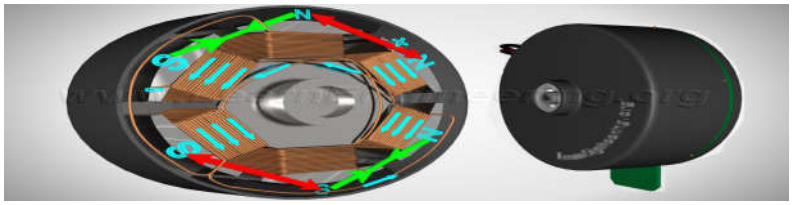


Figure 1- Brush Less Motor

2.1 Applications of Brushless Motor

- Brushless motors are ideally suited for manufacturing applications because of their high power density, good speed-torque characteristics, high efficiency, wide speed ranges and low maintenance.
- It is used in the electronic gadgets and toys.
- Thrust motors.
- Actuators for the movement of doors.
- Used in accelerators.
- It is high performance motor that provides large torque per cubic inch over a vast sped rang.
- BLDC motors do not have brushes which make it more reliable, high life expectancies, and maintenance free operation.
- There is no ionizing sparks from the commutator, and electromagnetic interference is also get reduced.
- Such motors cooled by conduction and no air flow are required for inside cooling.

3. Hunt For The Right Motor

We were looking for a DC Motor which was suitable for our project. We went to faulhauber (online seller) for motor. We searched and observed their data sheet and their characterstics. During search we found that BLDC was suitable for project.

3.1 The Road Not Taken

We performed a test for calculate linear range of (HCR-SR 04) Sensor. We found that after some specific distance the sensor doesn't work properly. We make a table of observation between actual distance and measured distance. After that based on value we plotted a graph between these values. We can see through graph that the sensor works up to certain distance. So, we move backward from this exercise. So finally, we decided that we will go through MATLAB software and solve transfer function of Motor in real time.

4 Measurement

Measurement in any scientific process has its own importance. The analysis is done on this basis whether research is heading in the right direction or not.

In this project measurement of current, voltage and resistance of the feedback is done. So it is required to interface and measure V,I,R across a resistance. The measurements are done with the help of Arduino platform on a simple ohmic resistance. The current, voltage and resistance are calculated on an experimental basis to check the reliability of operation in real time application in controlling of the motor through the feedback mechanism.

The experiment was performed on the motive of "Success or Perish".

Measure Voltage Through Resistor

Voltage is electric potential energy per unit charge, measured in joules per coulomb. It is often referred to as "electric potential", which then must be distinguished from electric potential energy by noting that the "potential" is a "per-unit-charge" quantity.

Measurement of the voltage across the resistor can be done with the help of Arduino. The setup needs a 5V battery to be connected to the terminals of the resistor. To measure the voltage across the terminal of resistor connect the jumper wires to A0 pin of Arduino board to one of the terminals of the resistor and another terminal to the ground pin of Arduino. Give supply to Arduino and load the source code.

The main objective of this experiment is to print voltage across resistor on the serial monitor.

The source code for experiment is:

```
void setup() {
Serial.begin(9600);
}
void loop()
{
double v=analogRead(A0);
double vv=(v/1023)*5.0001;
Serial.println(vv);
delay(500);
}
```

The source code for experiment of measurement of resistance:

```
void setup()
{
pinMode(A0,INPUT)
Serial.begin(9600);
}
void loop()
{
int read=analogRead(A0);
  float v=(5./1023.)*read;
  float i=(5-v)/68;
  float r=(v/i);
  float ii=i*1000000;
```

```
Serial.print("volt");
Serial.println(v);
Serial.println("micro amp");
Serial.println(ii);
Serial.println("resis");
Serial.println(r);
delay(500);
}
```

Explanation : the A0 pin will take the input in analog form, the voltage is processed and transformed in linear scale of 5volts. The processed voltage (vv) is displayed serial.print command.

Measure Current And Resistanceof Resistor

Current is the flow of electric charge. Electric current cause two important phenomena one is Joule heating thereby creates light in light bulb and other is magnetic fields which are used in motors, generators and inductors.

The main objective is measurement of current and resistance can be done with the help of this experiment.

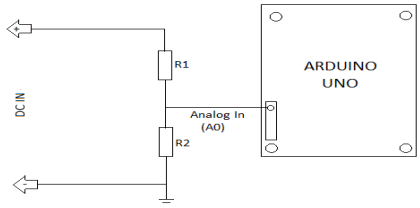


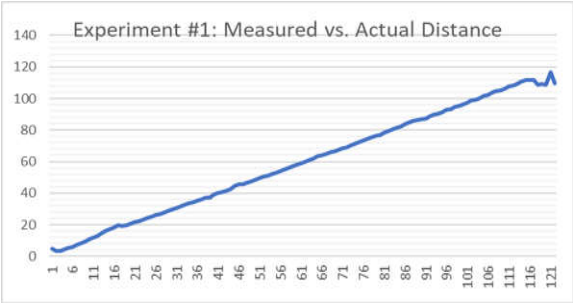
Fig 4.1. Sketch of connection

The potential divider circuit divide the voltage of main voltage source. Load voltage is VL and ohmic voltage is Vr is to be calculated, R(ohm)is known resistance and L(ohm) is resistance to be calculated.

The setup is built in a way to find resistance R, first analog voltage is read by A0 pin from jumper wire coming from terminal of load (unknown resistance). Supply of 5V is given to series connection of resistance R and L. Jumper wire is connected to A0 pin from L.

Source code is loaded to Arduino and then current, resistance and voltage is calculated.

Without the ability to measure, it would be difficult for scientists to conduct experiments or form theories. Not only is measurement important in science and engineering, it is also essential in farming, construction, manufacturing, commerce, and numerous other occupations and activities.



5 NICHROME FEEDBACK

Nichrome (NiCr, nickel-chrome, chrome-nickel, etc.) is any of various alloys of nickel, chromium, and often iron. For our test we require feedback in form of voltage. Initially we used a guitar string for feedback and after that we reach a conclusion that nichrome wire have all feature which require for linear range operation. Let we discuss some special properties of Nichrome wire give below. Following are some of the physical properties of nichrome :

Electrical Resistivity at room temperature: 1.0*10^-6 to 1.5*10^-6 ohm
Thermal Conductivity: 11.3 W/m degree centigrade
Magnetic Attraction: NONE
Thermal Expansion Coefficient (20 degree C to 100 degree C): 100ppm/degree C
Specific Gravity: 8.4
Density: 8400 kg/m^3
Melting point: 1400 degree C
Specific Heat: 450 J/kg degree C
Modulus of elasticity: 2.2*10^11
So We can use Nichrome as feedback in controlling of elevation of CLDC motor.

Fig 4.7: Nichrome wire

6.Result & Conclusion

The Controlling of the Motor is achieved via PID and Ultasonic Senson. Hardware and Software are uitilized using Arduino Board.
In Future, the parameters of PID control will be deducted using MATLAB. Therefore, data is numerically computed. Robustness and Optimal Control are scarcely discussed for lateral continuum.

7.Refrenaces-

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