1D Objective

1. Use a factorial design method to identify the design factors influencing the thrust efficiency of a propeller. Of the designs used in the study.
2. Identify the configuration that leads to maximum thrust efficiency.

Thrust efficiency is defined as the ratio of the power output to the power input.

Report Deadline

Upload to your groups folder in Edimension before 01 July 2022 11:59pm.

Deadline

An assignment submission on Edimension will be made available.

Report Guidelines

Each team needs to produce a two page (A4 with 11pt font) report that a least contains the following sections:

1. Author names and SUTD-ID
2. >100 word executive summary
3. Short introduction about your design concept and the reasons for adopting a particular Factorial Design approach (<0.25 page).
4. Results
    1. Must include an ANOVA table
    2. Ensure that the thrust at 2W for the most efficient design is clearly stated
    3. Include a photo of the best configuration
5. A discussion about the ANOVA results (0.5 to 1 page)
6. Conclusion (<0.25 page)
7. Appendix (this does not count toward the page limit)
    1. DoE table of results
    2. Any python code used

135mm enclosure

Marks

Marks will be awarded for:

- Application of methods taught in 30.100
- Creativity
- Report quality (English & presentation)

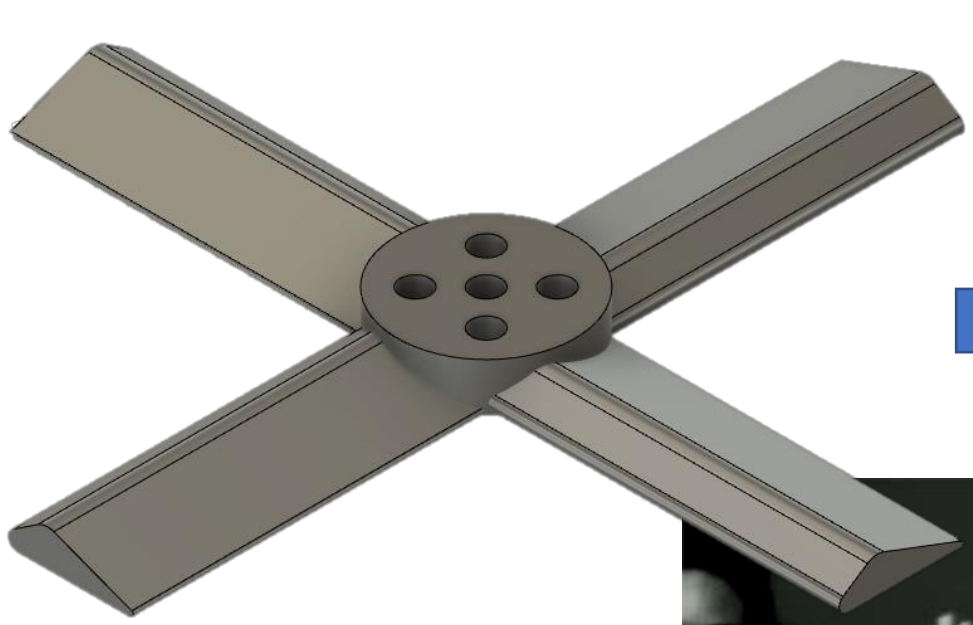
Bonus marks available for :

- Building and discussing a statistical model
  - This is not covered in the class but is covered in Chapter 7 of Montgomery's book
- Most efficient design in the cohort
  - If you would to be considered for this bonus mark, please include a link to a video that shows the thrust before applying the electrical power, the weight when 2W is applied, and then the electrical power supplied to the motor (current and voltage).

Advice

- Use the supplied core design (see Autodesk fusion file on E-dimension)
  - It will fit the screw holes in the motor
  - It is the correct thickness for screws that we will supply
- If using the Fablab printers
  - Print no more than 8 different configurations
  - Print all 8 in the same 3D printing run
  - Use the Fablab-supplied Cura configuration file
- Design a propeller that doesn’t require any printing supports
- Try to parameterise your CAD model so that it is easy to quickly change the design for different configuration levels
- The propellers spin at a high RPM, so make sure it is sufficiently strong to withstand the centrifugal force.

If you want it, then you should put a ring on it!



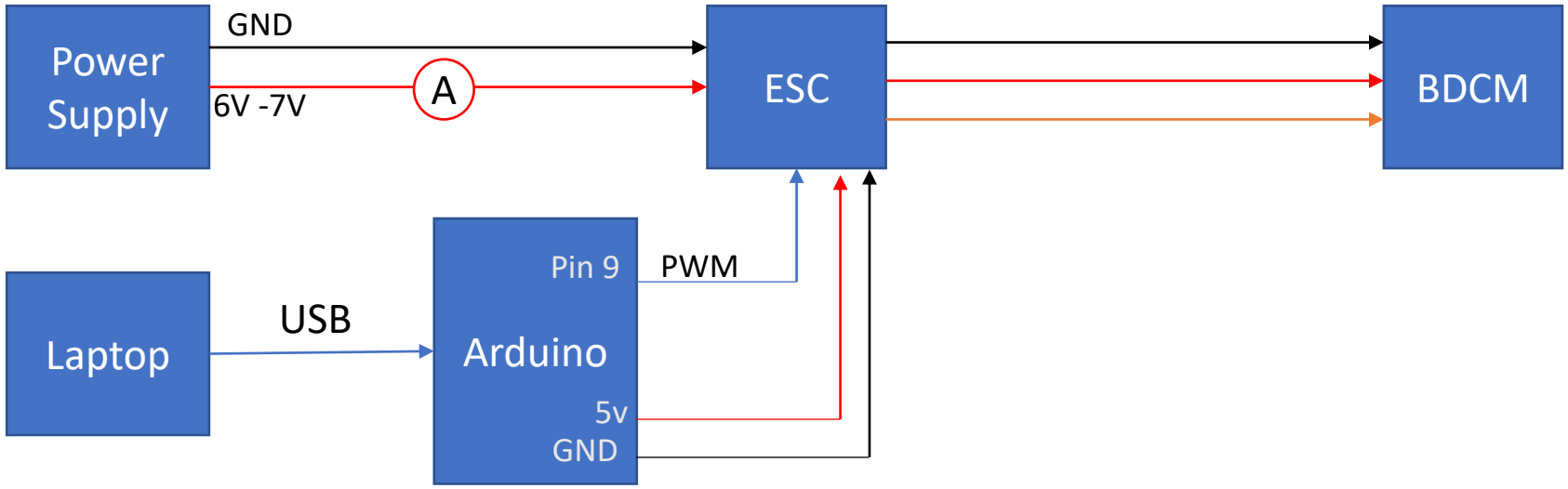
Safety

- Always wear goggles when testing the propeller
- Use the supplied cylinder

Measurement

- Measure force with balance/scales whilst applying 2W of electrical power.
- Do not apply 2W for more than 10 sec because overheating can occur
  - Other power levels are allowed but 2W is the power that the efficiency will be judged and must be reported.

Wiring Schematic



Arduino Control

bdcm_v6newesc §

```
void arm(){
 // arm the speed controller, modify as necessary for your ESC
 Serial.println("Arming");
 setSpeed(0);
 delay(3000); //delay 1 second,  some speed controllers may need longer
 Serial.println("Armed");
}

void rampup(int speed){
 // the old esc seems to not like sudden jumps in speed
 // So ramp up slowly
 for(speed = 10; speed <= 20; speed += 1) {
   Serial.println(speed);
   setSpeed(speed);
   delay(2000);
 }
}

void rampdown(int speed){
 // the old esc seems to not like sudden jumps in speed
 // So ramp up slowly
 for(speed = 20; speed >= 10; speed -= 1) {
   Serial.println(speed);
   setSpeed(speed);
```

Change the max speed in the loop

The program ramps up the speed every 2 seconds, and then ramps down again.

Read the weight when the power is 2W.

This code is in the 1D folder on edimension. You are welcome to edit it.