



THE UNIVERSITY
of ADELAIDE

Richard Saing
Jayden Hayward

Supervised by Derek Abbott & Andrew Allison

THE BALL BEARING MOTOR MYSTERY (142)

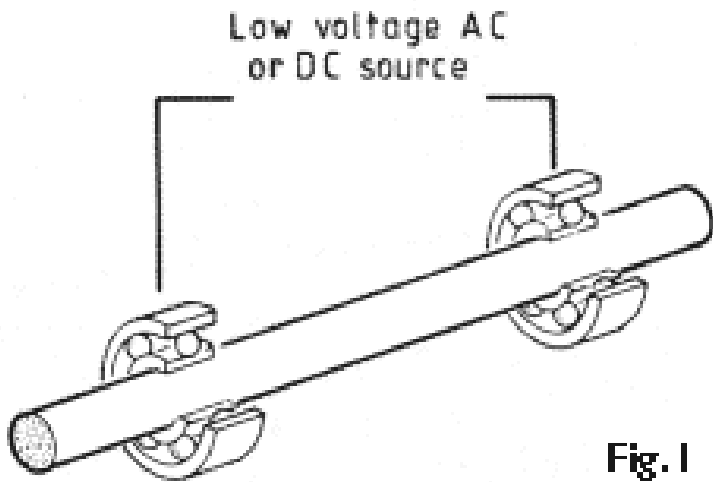
adelaide.edu.au

Outline

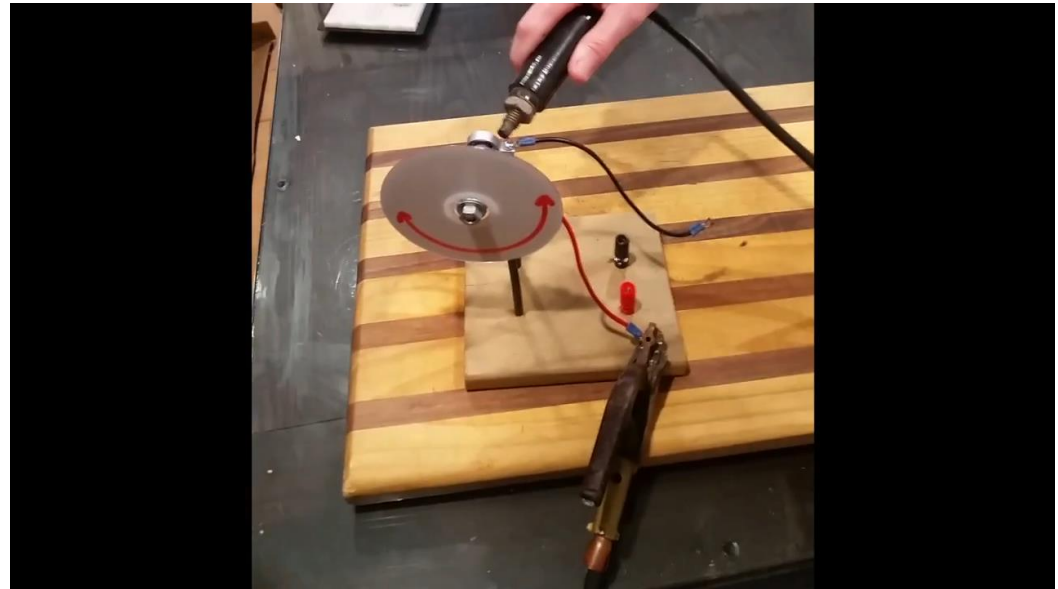
- **Introduction**
 - **Background**
 - **Previous Studies**
 - **Project Aims**
- **Design**
 - **Experiment and Motor**
 - **Budget**
- **Experiments**
 - **Results**
 - **Discussion**
- **Future Work**

Introduction

- **Background**



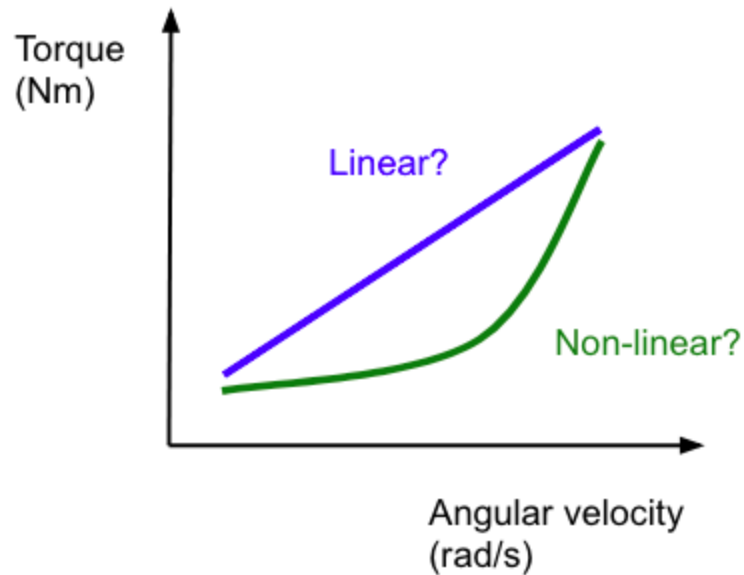
<http://www.electricstuff.co.uk/bbmotor.html>



Introduction

- **Background**

- Gruenberg's Electromagnetic theory predicts a squared relationship between angular velocity and torque



Introduction

- **Previous Studies**

- Large amounts of current to operate motor
- Rapid deterioration of the ball bearings
- Previous students submerged ball bearings in kerosene to reduce friction, thus reducing its self destructive behaviour



<https://d3vl3jxeh4ou3u.cloudfront.net/IISTD%20Damaged%20Wheel%20Bearing%20.jpg>

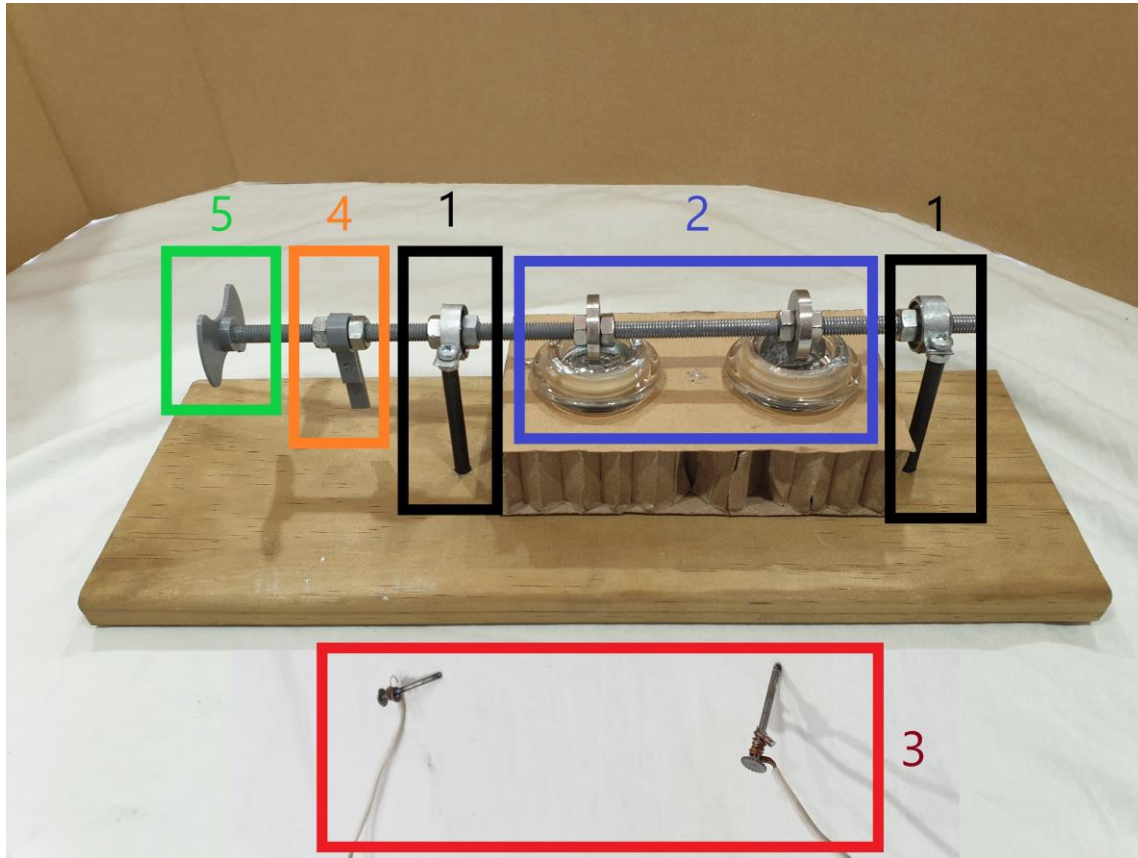
Introduction

- **Project Aims**

- Establish relationship between Angular Velocity and Torque
 - Test an alternative version of the motor
 - Investigate magnetic behaviour using simulation software

Design

- **Experiment and Motor**



Design

- **Experiment and Motor**

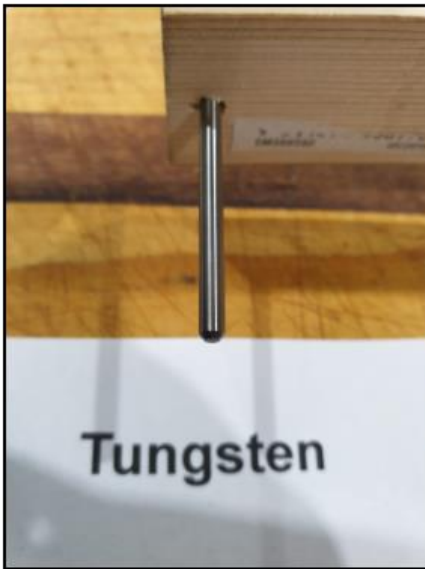
Gallium



<https://www.businessinsider.com/gallium-safe-metal-liquid-mercury-2016-5/?r=AU&IR=T>

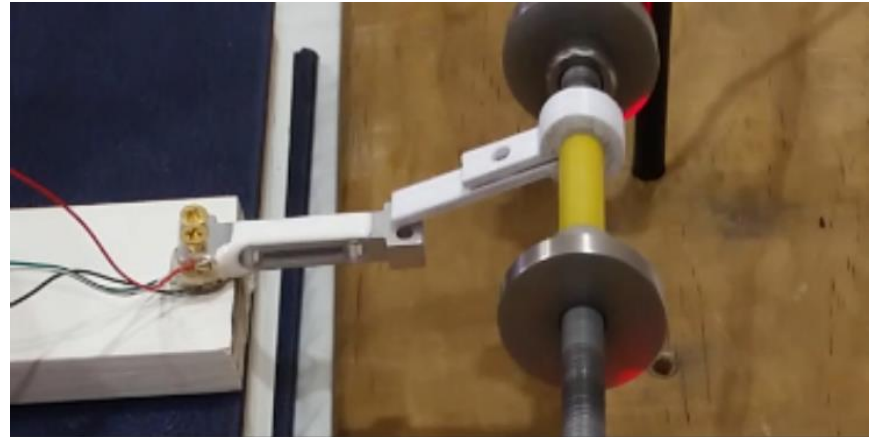
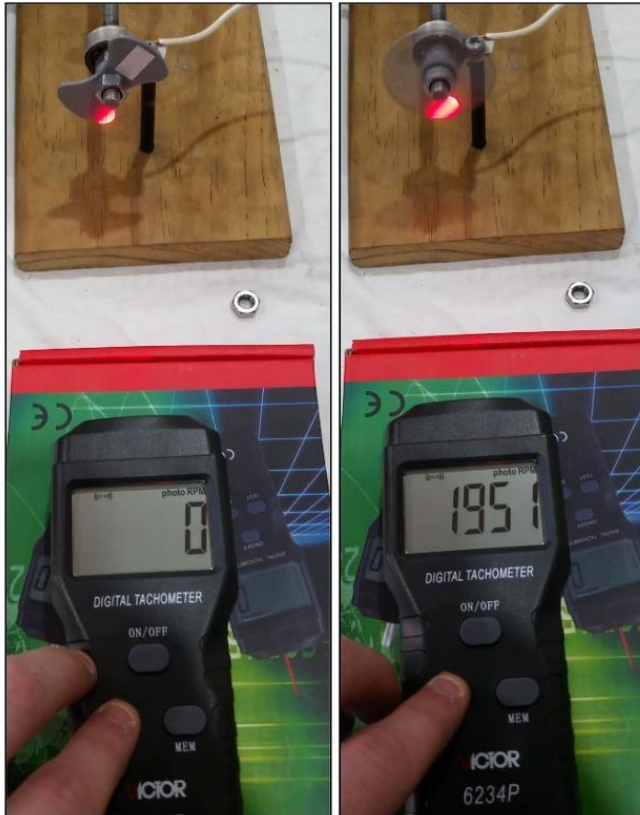
Design

- **Experiment and Motor**



Design

- Experiment and Motor



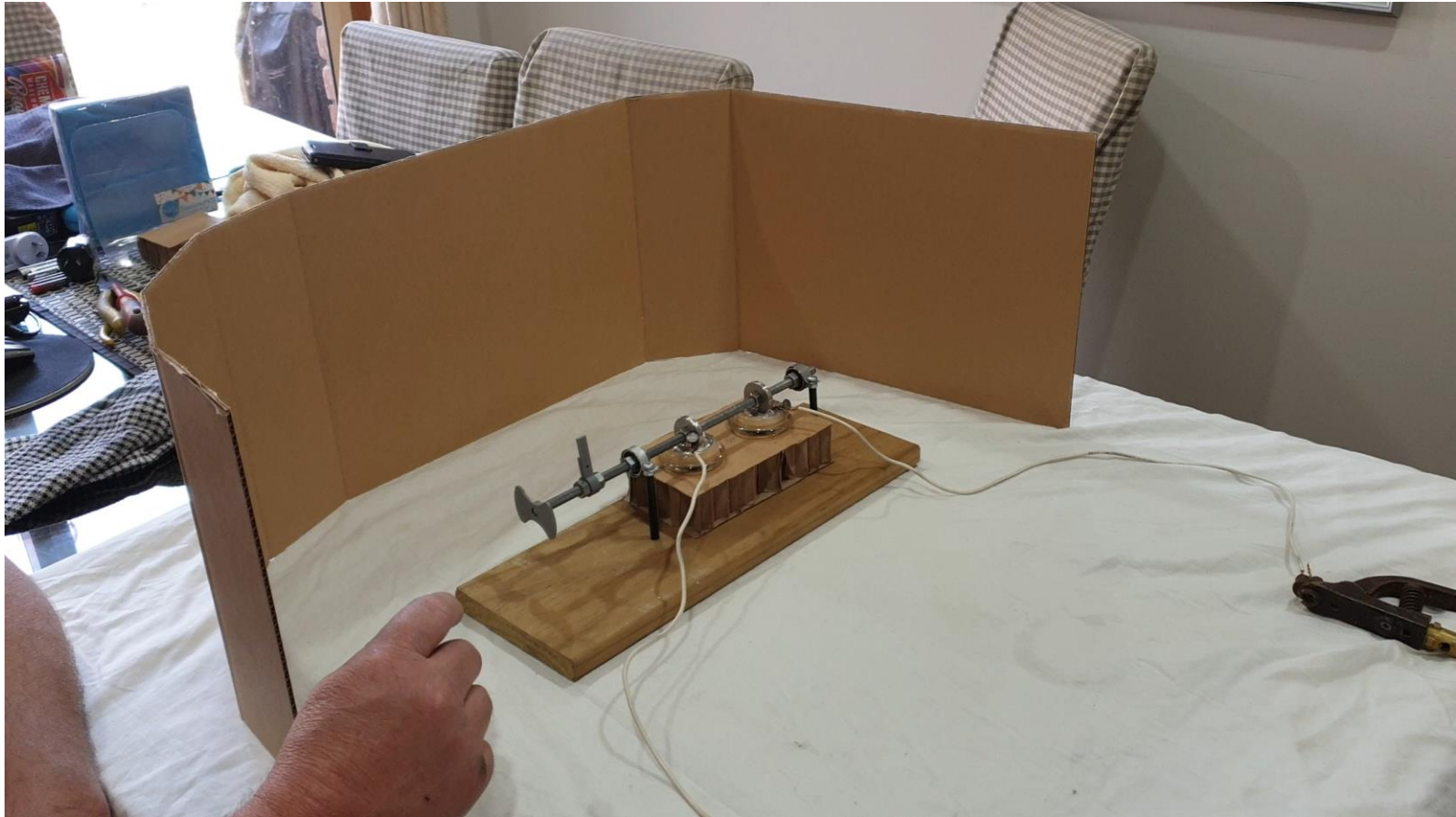
Design

- Budget

Item	Quantity	Cost for required items
Gallium (250g)	2	\$278.40
Tachometer	1	\$62.95
Arduino Mega	1	\$49.95
Tungsten rod	2	\$30
Ball bearing races	10	\$25
Mini Load Cell	1	\$25.67
Steel Shaft	1	\$15.70
Load Cell Signal Amplifier	1	\$9.95
Stainless steel discs	2	\$0
Encoder wheel	1	\$0 (3D printed)
Torque arm	1	\$0 (3D printed)
	Total Cost	\$497.62

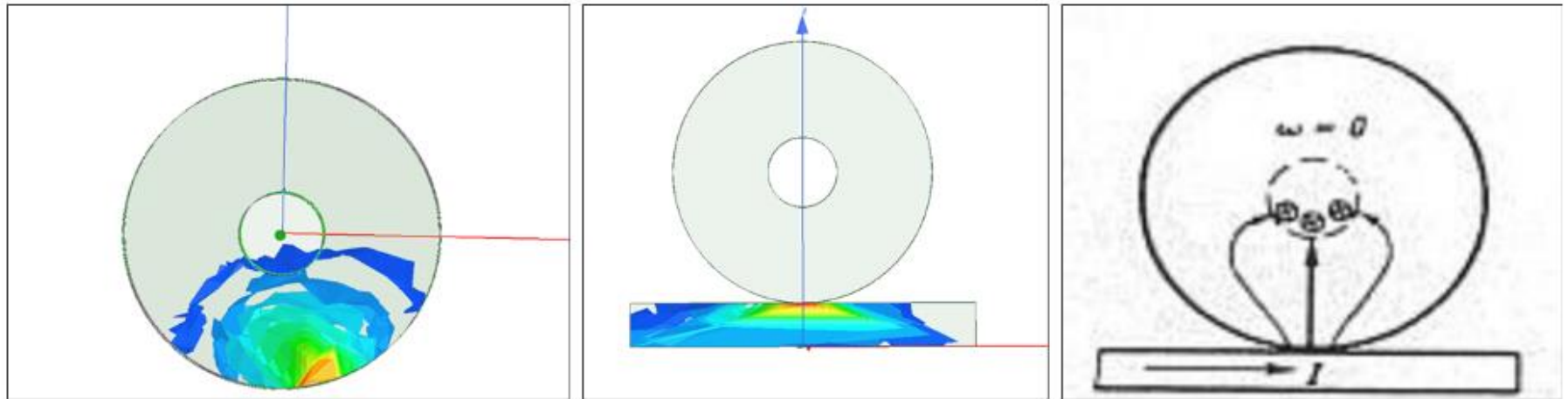
Experiments

- Results



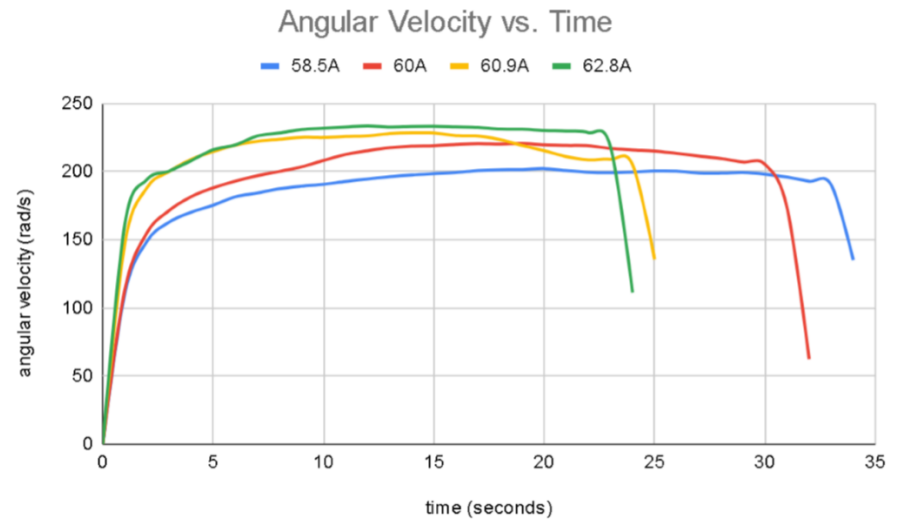
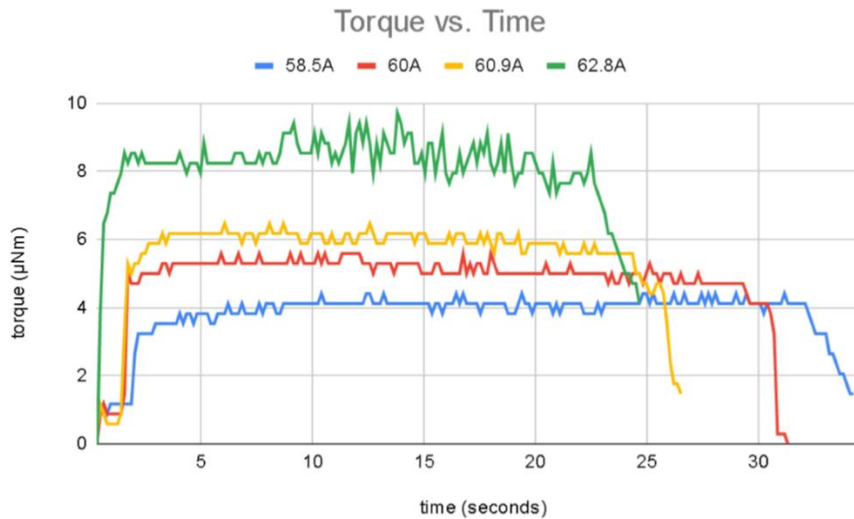
Experiments

- Results



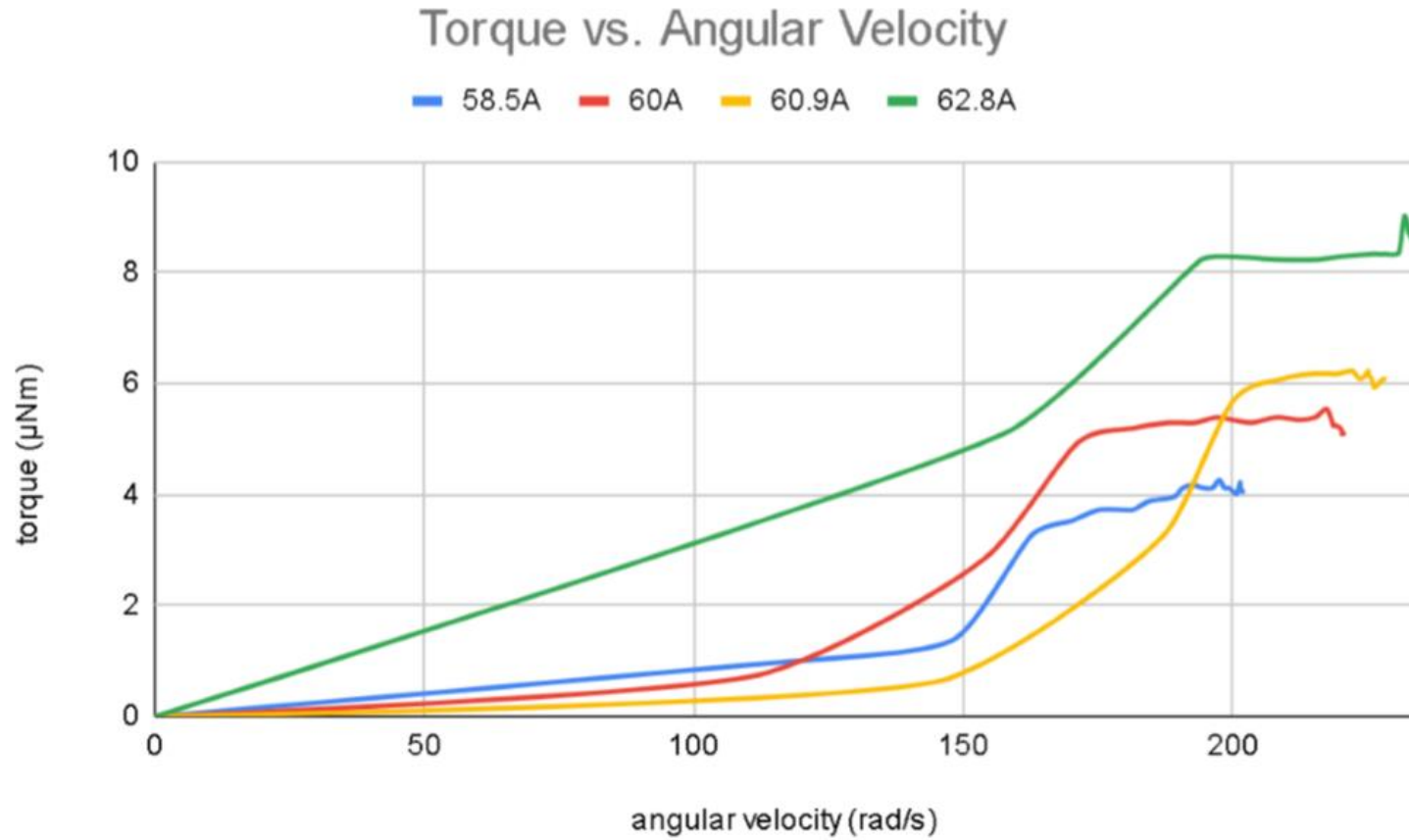
Experiments

- Results



Experiments

- Results



Experiments

- **Discussion**

- Simulations show magnetic field behaviour described by Silvestrov and Zimenkov
- As the angular velocity vs. torque relationship was found to be a squared one, Gruenberg's electromagnetic theory was favoured
- Results from this project does not sufficiently prove or disprove any of the theories

Future Work

- Repeat the alternative experiment with a smaller motor
- To experiment with different materials
- Repeat simulations using different programs



THE UNIVERSITY

of ADELAIDE

CRICOS PROVIDER NUMBER 00123M