The Title of My Thesis

A thesis submitted in partial fulﬁlment of the requirements

for the award of the degree

Bachelor of Engineering (Electrical)

from

University of Wollongong

by

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School of Electrical, Computer and Telecommunications Engineering

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Supervisor: Dr Zheng Li

ABSTRACT

According to some people, the abstract should be approximately 300 words, and no more than 700 words. It should be an ‘Informative Abstract’.

ACKNOWLEDGEMENTS

I would like to thank the Flying Spaghetti Monster for his guidance and constant inspiration . . .

Statement of Originality

I, Kane Stoboi, declare that this thesis, submitted as part of the requirements for the award of Bachelor of Engineering, in the School of Electrical, Computer and Telecommunications Engineering, University of Wollongong, is wholly my own work unless otherwise referenced or acknowledged. The document has not been submitted for qualiﬁcations or assessment at any other academic institution.

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TABLE OF CONTENTS

ABSTRACT ii

ACKNOWLEDGEMENTS iii

STATEMENT OF ORIGINALITY iii

TABLE OF CONTENTS iii

LIST OF FIGURES iii

LIST OF TABLES iii

1 Insert chapter heading here (Style Heading 1) 3

1.1 Insert sub Chapter One heading here (Style Heading 2) 3

CONCLUSIONS AND RECOMMENDATIONS (Style Preliminary Header) 3

REFERENCES (style preliminary header) 3

APPENDIX A TITLE 3

APPENDIX B TITLE 3

LIST OF tables

**No table of figures entries found.**

LIST OF figures

**No table of figures entries found.**

Abbreviations and Symbols

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| SM | Stepper Motor |
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1. Introduction

Stepper motors have become widely used in position sensitive applications such as robotics, antennas, printers and CNC machines due to their reliability, durability and precise position control. Although stepper motors were originally designed to provide precise position control without feedback sensors, such open-loop systems have their performance degraded [1].

Reliability and repeatability is of concern.

1. Literature Review

## Stepper Motors

The two main types of control methods for driving stepper motors today are current controlled drivers and voltage controlled drivers.

## Voltage Controlled Chopper Principle

Constant voltage or L/R stepper drivers supply a constant voltage to the stepper motor windings when the coils are energised.

## Current Controlled Chopper Principle

One issue that arises with constant voltage stepper motor drivers is their limited torque as rotor speed increases. This limitation can be seen from the following equation:

Voltage Across an Inductor:

Rearranging for di/dt

( 1 )

As the switching speed of the stepper motor coils increase that is di/dt decreases, VL must also decrease as the inductance of the motor is constant.

A Current Controlled Chopper can increase di/dt by chopping a higher voltage of up to eight times higher than the motors nominal voltage but uses a feedback loop to limit the current through the motor coils.

This chopping of voltage increases the noise.

Noise causes eddy currents to flow in the motor rotor (permanent magnet)

Eddy currents cause power loss and magnet reconstruction

The current ripple can also cause audio noise (which is to be eliminated)

1. Proposed Method

## Software

This project to initially use Simulink and MATLAB developed by Mathworks to develop a control system to incorporate an encoder.

## Hardware

AS5600 magnetic encoder

TMC2100 stepper motor driver

Arduino Uno board

Teensy 3.6 board

## Algorithms

1. CONCLUSIONS AND RECOMMENDATIONS

Insert conclusions and recommendations. (Style Normal)

REFERENCES (style preliminary header)

[1] L. Chrifi-Alaoui and A. Lebrun, "H∞ feedback control of a permanent magnet stepper motor," in *Proceedings of the IECON'97 23rd International Conference on Industrial Electronics, Control, and Instrumentation (Cat. No.97CH36066)*, 1997, vol. 1, pp. 108-113 vol.1.

APPENDIX A TITLE

APPENDIX B TITLE