DEVELOPMENT AND FEASIBILITY OF OPEN-SOURCE HARDWARE AND SOFTWARE IN CONTROL THEORY APPLICATION

by

DEREK J. BLACK

B.S., Kansas State University, 2014

A THESIS

submitted in partial fulfillment of the
requirements for the degree

MASTER OF SCIENCE

Department of Mechanical and Nuclear Engineering
College of Engineering

KANSAS STATE UNIVERSITY
Manhattan, Kansas

2017

Approved by:

Major Professor
Dr. Dale Schinstock

Copyright

Abstract

Control theory is a methodology investigated by many mechanical and electrical engineering students throughout most universities in the world. Because of control theory?s broad and interdisciplinary nature, it necessitates further study by application through laboratory practice. Typically the hardware used to connect the theoretical aspects of controls to the practical can be expensive, big, and time consuming to the students and instructors teaching on the equipment. This is due to the fact that connecting various hardware components such as sensors, encoders, amplifiers, and motors can lead to data that does not fit perfectly the theoretical mold developed in the controls classroom, further dissuading students of the idea that there exists a connection between developed theoretical models and what is seen in practice.

There is a recent trend in universities wishing to develop open-source, inexpensive hardware for various applications. This thesis will investigate and conduct a multitude of experiments on an apparatus known as the Motorlab to determine the feasibility of such equipment in the field of control theory application. The results will be compared against time-tested hardware to demonstrate the practicality of open-source, inexpensive hardware.

Table of Contents

List of Figures

List of Tables

Acknowledgments

Enter the text for your Acknowledgements page in the acknowledge.tex file. The Acknowledgements page is optional. If you wish to remove it, see the comments in the etdrtemplate.tex file.

Dedication

Enter the text for your Dedication page in the dedication.tex file. The Dedication page is optional. If you wish to remove it, see the comments in the etdrtemplate.tex file.

Preface

Enter the text for your Preface page in the preface.tex file. The Preface page is optional. If you wish to remove it, see the comments in the etdrtemplate.tex file.

Chapter 1

Chapter Title

In this chapter there examples of various features you may want to incorporate into your document. Here's an example of a figure inserted into the text:

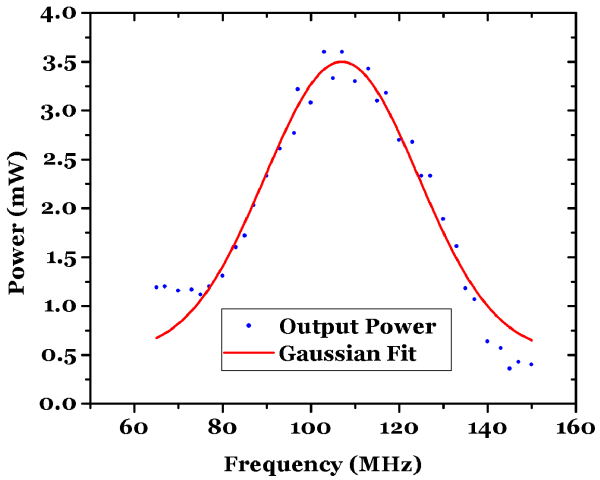

Figure 1.1: *Full caption to appear below the Figure*

See the file chapter1.tex for examples of the commands used to insert a figure or table, add a caption, etc. Here is an example of a table:

Table 1.1: *Caption to appear above the table*

Column 1 Heading	Column 2 Heading	Column 3 Heading
Col 1 Row 1	Col 2 Row 1	Col 3 Row 1
Col 1 Row 2	Col 2 Row 2	Col 3 Row 2
Col 1 Row 3	Col 2 Row 3	Col 3 Row 3

1.1 Making References to Figures or Tables

It is possible to create cross-references and hyperlinks to items or sections within your paper. For example, here is a reference to Fig. 1.1 mentioned at the beginning of this chapter and a reference to the Table 1.1.

1.2 Making a Reference to a Chapter Subsection

In this section, we refer back to text mentioned in Section 1.1 on page 2.

1.3 Making a Citation

Here's an example of a citation to a single work.[?] It's also possible to make multiple citations.[? ?]

This template uses BibTeX to manage and format citations. BibTeX is not the only way to create a bibliography within LaTeX, but it's generally considered to be the best option for long documents like a thesis or dissertation.[?] There are a few more sample citations in this paragraph so you can see examples of how in-text references are made and how the bibliography is formatted.[?] See the file "BibTeX Guide.pdf" for information on how to use BibTeX.

Chapter 2

This is Chapter 2

To refer to Chapter 1, use the slash ref command along with the "makereference" label which was assigned back at the beginning of Chapter 1.

2.1 Page Number References

It is possible to refer to a specific page number, such as page 1. Add a slash label command and a unique name for each page to be referenced later in the text.

2.2 Referring to Sections Within Chapter 1

It is possible to refer to sections within a chapter. Add a slash label command and a unique name with the section number for each section to be referenced later in the text. Her is an example of a figure in section 1.1 and an example of a table in section 1.2. In section 1.3, we looked at examples of bibliographic citations.

Chapter 3

This is Chapter 3

Here are more examples of references to previous sections. In Chapter 1 there were several sections, including section 1.1, section 1.2, and section 1.3.

Likewise, in Chapter 2, there are sections 2.1 and 2.2.

Appendix A

Title for This Appendix

Enter the content for Appendix A in the appendixA.tex file. If you do not have an Appendix A, see comments in the etdrtemplate.tex file for instructions on how to remove this page.

Appendix B

Title for This Appendix

Enter the content for Appendix B in the appendixB.tex file. If you do not have an Appendix B, see comments in the etdrtemplate.tex file for instructions on how to remove this page.