

GREAT CONTRIBUTION TO THE FIELD OF THINGS

THESIS

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AFIT-ENG-MS-XX-XXXX

**DEPARTMENT OF THE AIR FORCE
AIR UNIVERSITY**

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Wright-Patterson Air Force Base, Ohio

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THESIS

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Air University
Air Education and Training Command
in Partial Fulfillment of the Requirements for the
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Chair

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Member

Carl Gauss, Ph.D
Member

Abstract

This is a high-level explanation of the point of this research.

Keywords: earth; wind; fire

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To the one who loves me most.

Acknowledgements

I would like to thank the entire committee for your great support.

John Smith

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I. Introduction

1.1 AFIT Style Guide, L^AT_EX Help, and Slides

This thesis and dissertation template follows the latest AFIT Style Guide. If you need help with writing L^AT_EX code, refer to the L^AT_EX Primer by David Woodburn.

Once you have written your thesis, you will likely also need to create a presentation. Rather than converting your content into a PowerPoint[™]-friendly format, you can also create a pdf-based slide presentation using L^AT_EX. The template for this can be found on Overleaf.com as “AFIT Defense Template”.

1.2 Class Option

The `afitthesis` class can take the font size as an option: `10pt`, `11pt`, or `12pt`. The default is `11pt`.

1.3 Document Variables

Rather than having to type your name or the title of the thesis (or dissertation) over and over, you instead need to write them once as the inputs to the following macros:

<code>\title{}</code>	<code>\address{}</code>
<code>\author{}</code>	<code>\distribution{}</code>
<code>\rank{}</code>	<code>\disclaimer{}</code>
<code>\previousdegrees{}</code>	<code>\copyrightstatement{}</code>
<code>\newdegree{}</code>	<code>\committee{{name}\Chair}, {name}\Member}}</code>
<code>\graduationdate{}</code>	<code>\abstract{}</code>
<code>\department{}</code>	<code>\keywords{}</code>
<code>\doctype{}</code>	<code>\dedication{}</code>
<code>\docdesignator{}</code>	<code>\acknowledgments{}</code>

The `\doctype{}` should be one of `thesis`, `dissertation`, or `graduate research paper`. Several of these variables already have default values if you do not define them yourself. Note that the `\committee` is a list of people and their roles. Each should be encased in braces.

The `\keywords` should be a semicolon-delimited list of keywords (maximum of 3) for your document. If you have more than one author for your document, you can define additional authors and their ranks using the following commands:

<code>\authorsecond{}</code>	<code>\ranksecond{}</code>
<code>\authorthird{}</code>	<code>\rankthird{}</code>
<code>\authorfourth{}</code>	<code>\rankfourth{}</code>

1.4 Standard Form 298

All theses and dissertations must be accompanied by a Standard Form 298. This L^AT_EX class file has an updated 2020 version of the form builtin. The form can also be downloaded from <https://www.gsa.gov/forms-library/report-documentation-page>. Note, the instructions for this form can also be found there. To add the form to your paper, the last command before `\end{document}` should be `\sfTwoNineEight`. To fill in the fields of this form, use the following commands:

<code>\sfReportDate{}</code>	<code>\sfSponsorAgency{}</code>
<code>\sfReportType{}</code>	<code>\sfSponsorAcronyms{}</code>
<code>\sfStartDate{}</code>	<code>\sfSponsorReportNumber{}</code>
<code>\sfEndDate{}</code>	<code>\sfAbstract{}</code>
<code>\sfContractNumber{}</code>	<code>\sfReportClassification{}</code>
<code>\sfGrantNumber{}</code>	<code>\sfAbstractClassification{}</code>
<code>\sfProgramElementNumber{}</code>	<code>\sfPageClassification{}</code>
<code>\sfProjectNumber{}</code>	<code>\sfAbstractLimitation{}</code>
<code>\sfTaskNumber{}</code>	<code>\sfResponsiblePerson{}</code>
<code>\sfWorkUnitNumber{}</code>	<code>\sfPhoneNumber{}</code>

The rest of the needed information is automatically retrieved from the document variables: `\title`, `\author`, etc. However, you can override those definitions with the following commands:

<code>\sfTitle{}</code>	<code>\sfDocDesignator{}</code>
-------------------------	---------------------------------

`\sfRank{}` `\sfDistribution{}`
`\sfAddress{}` `\sfSubjectTerms{}`
`\sfPageCount{}`

1.5 Prefatory Lists

If your document has figures, tables, or algorithms, a corresponding list will be created for you at the beginning of the document. You do not need to specify this yourself with a command like `\listoffigures`. This automation, however, does sometimes require multiple compilations.

1.6 Content Location

Any content (like chapters) can be moved into their own files and then included into your main document using the `\input{filename.tex}` command. You do not have to keep all your content in one file!

You can put all your figures into a subfolder and then tell L^AT_EX where to look for figures by using the `\graphicspath{{ }}` command, where the folder name (e.g., `figs/`) would go inside the *double* braces.

1.7 Equations

Table 1 is a list of math commands that have been added to this document class for your convenience.

1.8 Figures

Your figures should be clear and easy to understand (see Fig. 1). Avoid pixelated figures and text that is too small to read. To prevent pixelation, it is generally a good idea to save your figures as pdf images. This is one excellent reason to use L^AT_EX instead of Word, because Word cannot handle vector images. *Please note that for pdf images to load correctly, you need to use the pdfLaTeX compiler, not the LaTeX compiler.* In Python (using Matplotlib) you can use the `savefig` command to save your figure as a pdf. Take care to make sure the image is not so large compared to the font size that when it is inserted into your paper, the text is hard to read. Sadly, saving a figure in MATLAB as a pdf is not as easy. While there is an option, the resulting figure will be a full page with your image in the middle and

Table 1. List of convenience macros.

Code	Symbol	Description
<code>\ul{a}</code>	\underline{a}	vector
<code>\bm{A}</code>	\mathbf{A}	matrix
<code>\EE{2.7}{-3}</code>	2.7×10^{-3}	scientific notation value
<code>\diff{y}{x}</code>	$\frac{dy}{dx}$	derivative
<code>\piff{y}{x}</code>	$\frac{\partial y}{\partial x}$	partial derivative
<code>\abs{a}</code>	$ a $	absolute value
<code>\norm{\ul{a}}</code>	$\ \underline{a}\ $	norm of vector
<code>\ssm{\ul{a}}</code>	$[\underline{a}]_{\times}$	skew-symmetric matrix
<code>\upc{x}</code>	c_x	abbreviated cosine
<code>\ups{x}</code>	s_x	abbreviated sine
<code>\upt{x}</code>	t_x	abbreviated tangent
<code>\upd</code>	d	differential operator
<code>\upi</code>	i	imaginary number
<code>\upj</code>	j	second basic quaternion
<code>\upk</code>	k	third basic quaternion
<code>\upe</code>	e	Euler's number (2.718...)
<code>\PI</code>	π	Archimedes' constant (3.141...)
<code>\argmax</code>	arg max	argument of maximum
<code>\argmin</code>	arg min	argument of minimum
<code>\tr</code>	tr	trace of matrix
<code>\adj</code>	adj	adjugate of matrix
<code>\sgn</code>	sgn	sign of expression
<code>\micro</code>	μ	10^{-6} SI prefix, as in μs

The `\PI` (π) macro differs from `\pi` (π). Constants should be upright and variables should be italicized. Since the builtin `\pi` (π) is italicized, `\PI` (π) was created. Note that `\micro` does not have to be within a math environment.

large margins all around. To resolve this you need a few commands. First, you should set the margins and size of your figure:

```
1 set(gcf, 'units', 'centimeters', 'position', ...  
2     [0, 0, width, height])
```

For two-column documents, a width of 8.636 cm (3.4 in.) is a good choice. For a thesis, a width of 15.24 cm (6 in.) is recommended. You might want to set the font size and type too:

```
3 set(gca, 'FontSize', 9);  
4 set(gca, 'FontName', 'Times New Roman');
```

Finally, you need to export the graphic to a file:

```
5 exportgraphics(gcf, 'fig_plot.pdf', 'ContentType', 'vector');
```

When you place your figure, make sure to put the captions *below* the figure.

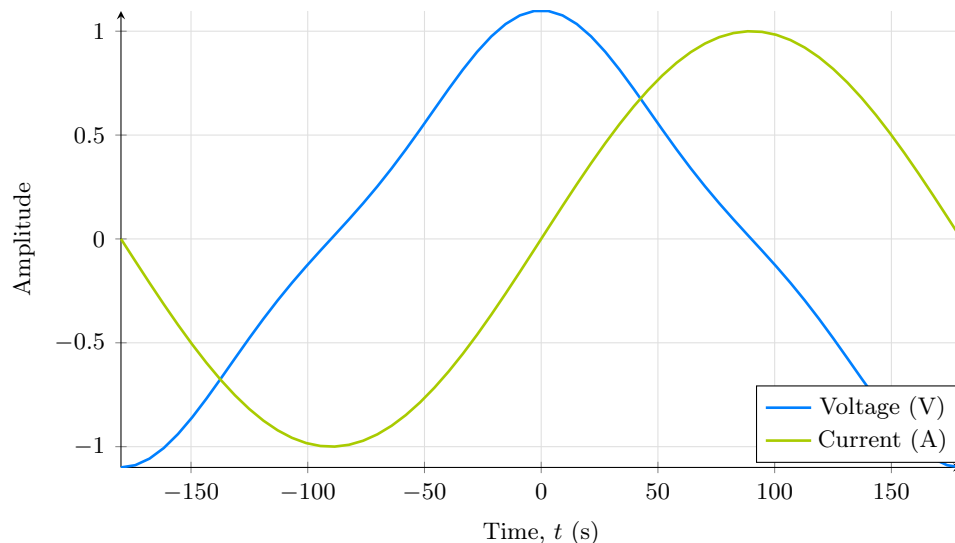


Figure 1. This is a figure.

1.9 Tables

Make sure to put table captions *above* the table (see Table 2).

1.10 Code and Pseudocode

If you have code you wrote or used for your thesis, generally you should not show the actual code. Some readers might not be familiar with the particular programming language you are using and often showing explicit code gets too much into the details of the lan-

Table 2. This is a table with left alignment for the first column and center alignment for the rest of the columns.

Unit	pt	cm	in
pt	1.0	28.45274	72.26999
cm	0.03514	1.0	2.54
in	0.01384	0.3937	1.0

guage. Rather, use pseudocode with math expressions where appropriate. For this, use the `pseudocode` environment. Keywords like `if`, `then`, `else`, `while`, and `function` will be automatically formatted in bold. The reason for using the left arrow (`\gets`) instead of an equals sign is that an equals sign implies that at all points in a flow of equations the equality is true, whereas the left arrow implies that the equality is only necessarily true at that point in the algorithm and henceforth until it is redefined.

If you want to be able to cite the pseudocode, wrap the `pseudocode` environment in an `algorithm` environment, just like a `tabular` environment within a `table` environment. An example algorithm is shown in Algorithm 1.

If for some reason, you really need to put actual computer code into your paper, the `python`, `matlab`, and `rlang` environments have been created for you. These will automatically syntactically highlight the source code. You can control the starting line number by using the optional parameter: `\begin{matlab}[7]`.

You can also have L^AT_EX read the source code directly from another file. The commands are

Algorithm 1. This is some pseudocode.

```

1  function factorial( $N$ )
2      print "Calculating factorial ..."
3       $x \leftarrow 1$ 
4      for  $n$  in 1 to  $N$ 
5           $x \leftarrow x \cdot n$ 
6      end for
7      return  $x$ 
8  end function

```

Python	<code>\inputpython{file.py}{1}{6}</code>
MATLAB	<code>\inputmatlab{file.m}{1}{6}</code>
R	<code>\inputrlang{file.r}{1}{6}</code>

The first parameter is the name of the file to read the code from. The second parameter is first line to read, and the third parameter is the last line to read.

You can also include small code expressions in a paragraph using a command similar to the L^AT_EX-builtin `\verb` command. For Python, write the `\py` command followed by a character like ‘|’, the text, and then the same character. So, `\py|np.array(["A", 1.5])|` will produce `np.array(["A", 1.5])`. For MATLAB, the command is `\mat` and for R it is `\rlng`.

1.11 Including PDF Pages

If you need to insert whole pages from some other pdf document, use the `\includepdf` command. To include specific pages, use a comma-separated list:

```
\includepdf [pages={2,3,5}] {paper.pdf}
```

To insert a range of pages, use a dash:

```
\includepdf [pages={2-5}] {paper.pdf}
```

To insert the whole document, drop the braces and just use a dash:

```
\includepdf [pages=-] {paper.pdf}
```

1.12 Citation

The AFIT Style Guide permits any standard style for citations, like IEEE or APA. It is recommended you use `.bib` files for your bibliographic information. Refer to https://www.overleaf.com/learn/latex/Bibliography_management_with_biblatex for guidance. The default citation style here is APA. To cite a reference, use the `\parencite{}` command. If you have multiple things to cite together, use the command once and separate the references with commas. So, the command

```
\parencite{poor1989, savage2000, savage2015}
```

would produce (Poor, 1989; Savage, 2000, 2015).

In order to give you full flexibility, the bibliography feature is not built into the template. Rather, the code is near the beginning of this document. If you would prefer to use the IEEE style, change the `\usepackage` command to

```
\usepackage[style=ieee]{biblatex}
```

The following command reads in the bibliography data from a separate file:

```
\addbibresource{refs.bib}
```

In this template, that data is actually stored inline, and there is no `refs.bib` file, but you will probably want to make that a separate file for your actual thesis.

Finally the `\printbibliography` command near the end of the document actually generates the bibliography.

II. Literature Review

III. Methodology

IV. Results and Analysis

V. Conclusion

Appendix A. List of Acronyms

A.1 Section

A.1.1 Subsection

If you wish, you can use more complicated methods for acronyms, such as the glossaries package. However, simply defining a macro for a name can be sufficient:

```
\def\afit{Air Force Institute of Technology}
```

Then, when you need to list all your acronyms, simply make a table, referencing your list of defined acronyms. The AFIT Style Guide permits putting your lists of acronyms, symbols, and such into the appendices section of your paper.

Bibliography

- Poor, W. A. (1989). A geometric description of wander azimuth frames. *Journal of the Institute of Navigation*, 36(3).
- Savage, P. G. (2000). *Strapdown analytics ii, part 1*. Strapdown Associates.
- Savage, P. G. (2015). Computational elements for strapdown systems. *Strapdown Associates, Inc.*

Vita

If you are adding a description about yourself. Use the `vita` environment. Keep the contents to one page. If for some reason there is more than one author contributing to this paper, each author should have a separate page.

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