

**DOING GREAT THINGS AS A STUDENT**

THESIS

John Doe, First Lieutenant, USAF

AFIT-ENG-MS-XX-XXXX

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THESIS

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DOING GREAT THINGS AS A STUDENT

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Committee Membership:

Albert Einstein, Ph.D  
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Carl Gauss, Ph.D  
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## **Abstract**

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

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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 Doe

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## I. Introduction

### 1.1 Document Class Options

The first line of your  $\text{\LaTeX}$  document should specify the document class:

```
\documentclass{afitthesis}
```

You can pass a few options to this document class. You choose the body text font size: 10pt, 11pt, or 12pt. The default is 11pt. You can specify if IEEE (e.g., “[1]”) or author-year (e.g., “(Savage, 2015)”) style citation references should be used. The default is author-year. To specify the IEEE style, pass the option `ieee`. So, if we wanted to use 12 pt font and use IEEE style, we would write the following as our first line:

```
\documentclass[12pt, ieee]{afitthesis}
```

*Please note that the AFIT Style Guide does not number sections and subsections, only chapters. This is on purpose.* However, if you and your adviser choose to deviate from this rule, you can use the optional parameter `numbered` to add IEEE-style numbering to sections, subsections and subsubsections:

```
\documentclass[numbered]{afitthesis}
```

### 1.2 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  $\text{\LaTeX}$  where to look for figures by using the `\graphicspath{{ }}` command, where the folder name (e.g., `figs/`) would go inside the *double* braces.

### 1.3 Equations

To reference figures, tables, and algorithms, you would use the generic `\ref` command. To reference an equation, you can use the `\eqref` command. So, the following equation is referenced by using its label: `\eqref{eq_formula}`. Our first equation is (1).

$$\frac{dy}{dx} = 2 \cos(2\pi\theta) + 5.2i + \Omega \quad (1)$$

Here is a list of convenience commands that have been added:

<code>\diff{}{}</code>	$\frac{dy}{dx}$	derivative
<code>\pdiff{}{}</code>	$\frac{\partial y}{\partial x}$	partial derivative
<code>\abs{}</code>	$ a $	absolute value
<code>\norm{}</code>	$\ \underline{a}\ $	norm of vector
<code>\ssm{}</code>	$[\underline{w}]_{\times}$	skew-symmetric matrix
<code>\upd</code>	d	differential operator
<code>\upe</code>	e	Euler's number
<code>\upi</code>	i	first basic quaternion
<code>\upj</code>	j	second basic quaternion
<code>\upk</code>	k	third basic quaternion
<code>\PI</code>	$\pi$	Archimedes' constant (3.14159...)

The `\PI` ( $\pi$ ) macro differs from `\pi` ( $\pi$ ). Constants should be upright and variables should be italicized. Since the builtin `\pi` ( $\pi$ ) is italicized, `\PI` ( $\pi$ ) was created.

If you need to show units with a micro prefix, use the `\micro` command, as in  $10^6 \mu\text{s}$ .

## 1.4 Figures

Here is Figure 1 showing the Air Force Institute of Technology (AFIT) crest. Using `htbp!` encourages L<sup>A</sup>T<sub>E</sub>X to keep the figure “here”. However, note that L<sup>A</sup>T<sub>E</sub>X will not always follow your request. To reference a figure, write “Figure” or “Fig.”, a tilde (~), and the generic `\ref` command: `Figure.~\ref{fig_first}`. The tilde makes sure that “Figure” and the number are never separated on different lines of text. Make sure to put figure captions *below* the figure.

*Please note that for pdf images to work correctly on OverLeaf, you need to use the pdfLaTeX compiler, not the LaTeX compiler.*

When you save a figure from MATLAB, (1) make sure the figure is clear and does not get pixelated, (2) remove excess white space from the sides of the figure, and (3) make sure

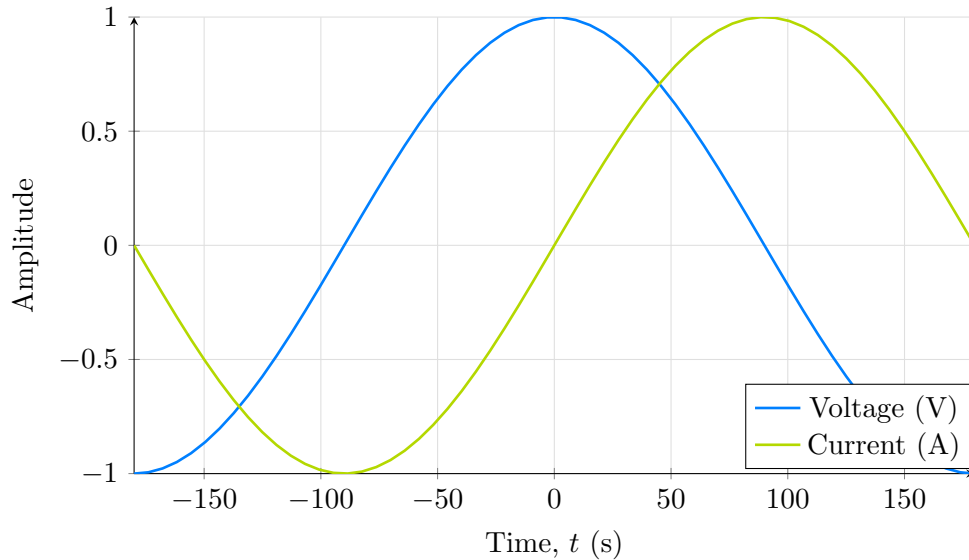


Figure 1. This is a figure.

the text size is large enough to see. These can all be accomplished by running the following function immediately after you have created the plot:

```

1  function savepdf(name, width, height)
2      % name is the file name including ".pdf".
3      % Both width and height are in (cm).
4      if nargin < 1 || isempty(name)
5          name = "fig.pdf";
6          width = 8.636;
7          height = 5.3373;
8      elseif nargin < 2 || isempty(width)
9          width = 8.636;
10         height = 5.3373;
11     elseif nargin < 3 || isempty(height)
12         height = width*0.618;
13     end
14
15     set(gcf, 'units', 'centimeters', ...
16            'position', [0, 0, width, height])
17     set(gca, 'FontSize', 9);
18     set(gca, 'FontName', 'Times New Roman');
19     exportgraphics(gcf, name, ...
20            'ContentType', 'vector');
21 end

```

Put this function into your “MATLAB” folder, and it will always be accessible by whatever

script you are running. For two-column documents, a width of 8.636 cm (3.4 in.) is the default. For a thesis, a width of 15.24 cm (6 in.) is recommended.

## 1.5 Tables

In  $\text{\LaTeX}$  you can align tables left, right, or center. However, the AFIT Style Guide requires that columns with only decimal values be aligned along the decimal point. This is not a builtin feature of  $\text{\LaTeX}$ . However, a decimal alignment style has been added for you. Use the ‘.’ column type to align numbers along their decimal points. Make sure to put table captions *above* the table.

Table 1. This is a table. See how the decimal values are aligned along their decimal points.

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

Also, by default, the alignment specifiers do not support multi-line text in a single table cell. So, three additional alignment specifiers are provided: **L**, **C**, and **R**. These each take one parameter: the width of the column. So, if you wanted a column to be left aligned and exactly 3 cm wide so that any text wider than that would automatically wrap, use the alignment specifier `L{3cm}`.

## 1.6 Code and Pseudocode

If you have code you wrote or used for your thesis, generally you would 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 language. Rather, use pseudocode with math expressions where appropriate. For this, use the `pseudocode` environment. Keywords like `if`, `then`, `else`, and `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. In order to write the algorithm shown in Algorithm 1, you would type the following:

```
function factorial($N$)
  print "Calculating factorial ..."
  $x \gets 1$
  for $n$ in $1$ to $N$
    $x \gets x \cdot n$
  end for
  return $x$
end function
```

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
```

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. (This means for some Python code, for example, prefix your code with `\begin{python}` and postfix it with `\end{python}`.) These will automatically syntactically highlight the source code. Here is an example in Python:

```
1  def factorial( $N$ ):
2    print("Calculating factorial ...")
3     $x = 1$ 
4    for  $n$  in range(1,  $N + 1$ ):
5         $x *= n$ 
```



Optionally, you can control the starting line number. If you wanted the above code to start line numbering at 7, you would prefix the code with `\begin{python}[7]`.

You can also have L<sup>A</sup>T<sub>E</sub>X read the source code directly from another file. The commands are

```
Python    \inputpython{file.py}{1}{6}
MATLAB    \inputmatlab{file.m}{1}{6}
R         \inputrlang{file.r}{1}{6}
```

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<sup>A</sup>T<sub>E</sub>X-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`.

## 1.7 Citation

The AFIT Style Guide permits a few styles for citations. The preferred style is the author-year. So, a paper by W. A. Poor in 1989 would be cited as (Poor, 1989). To achieve this, your bibliography entry would start like this

```
\bibitem[Poor, 1989]{poor1989} W. A. Poor, ``A Geometric Description of
```

where the `[Poor, 1989]` is the text that will be displayed when you cite it (except surrounded by parentheses instead of brackets) and `(poor1989)` is the label you would use to cite it: `(\cite{poor1989})`. If you have multiple citations in a group, separate them with semicolons. So, the code

```
(\cite{doe1998}; \cite{smith2003}; \cite{cane2008})
```

would render as “(Doe, 1998; Smith, 2003; Cane, 2008).” One of the advantages of this method is that it gives better context to the citation than a simple number because it tells

the reader who the author is and when it was written. Another advantage is that it does not require sorting your bibliography by order of appearance. Instead, you need to sort alphabetically by the first author's last name. This means that much of the automation of complex packages like `BIBTEX` is unnecessary.

However, if for some reason you are required to use the IEEE style of citation, simply remove the optional (bracketed) parameters to the `\bibitem` commands, remove the extra pairs of parentheses around the `\cite` commands, and add the `ieee` option to your document class:

```
\documentclass[ieee]{afitthesis}
```

## 1.8 Standard Form 298

All theses and dissertations must be accompanied by a Standard Form 298. This `LATEX` class file has builtin an updated 2020 version of the form. The form can 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:

```
\sfReportDate{}           \sfSponsorAcronyms{}
\sfReportType{}          \sfSponsorReportNumber{}
\sfStartDate{}           \sfAbstract{}
\sfEndDate{}             \sfSubjectTerms{}
\sfContractNumber{}     \sfReportClassification{}
\sfGrantNumber{}        \sfAbstractClassification{}
\sfProgramElementNumber{} \sfPageClassification{}
\sfProjectNumber{}      \sfAbstractLimitation{}
\sfTaskNumber{}         \sfResponsiblePerson{}
\sfWorkUnitNumber{}     \sfPhoneNumber{}
\sfSponsorAgency{}     
```

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 com-

mands:

<code>\sfTitle{}</code>	<code>\sfDocDesignator{}</code>
<code>\sfRank{}</code>	<code>\sfDistribution{}</code>
<code>\sfAddress{}</code>	<code>\sfPageCount{}</code>

## II. Literature Review

### III. Methodology

## IV. Results and Analysis

## V. Conclusion

## Appendix A. List of Acronyms

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

- W. A. Poor, "A Geometric Description of Wander Azimuth Frames," *Journal of the Institute of Navigation*, vol. 36, no. 3, Fall 1989. [Online serial].
- P. G. Savage, *Strapdown Analytics II, Part 1*, Strapdown Associates, Inc., 2000.
- P. G. Savage, "Computational Elements For Strapdown Systems," Strapdown Associates, Inc., 2015.

## 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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