NAVAL POSTGRADUATE SCHOOL

MONTEREY, CALIFORNIA

HYPERDRIVE: PRACTICAL, LOW COST, AND FUEL EFFICIENT TRAVEL TO THE STARS

by

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Darth Vader

June 2104

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The idea of Hyperdrive relies on the existence of a separate and adjacent dimension most commonly called "hyperspace," though various other names have been used: "Drivespace," "The Immaterium," "slipspace," "Space2," "subspace," "Zero-space," etc. When activated, the hyperdrive shunts the starship into this other dimension, where it can cover vast distances in an amount of time greatly reduced from the time it would take in "real" space. Once it reaches the point in hyperspace that corresponds to its destination in real space, it re-emerges. Usually, hyperdrive refers to a method of travel in which it takes a measurable amount of time to go from one point to another. When the distance is covered instantaneously, the term jump drive is often used.

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ABSTRACT

The idea of Hyperdrive relies on the existence of a separate and adjacent dimension most commonly called "hyperspace," though various other names have been used: "Drivespace," "The Immaterium," "slipspace," "Space2," "subspace," "Zero-space," etc. When activated, the hyperdrive shunts the starship into this other dimension, where it can cover vast distances in an amount of time greatly reduced from the time it would take in "real" space. Once it reaches the point in hyperspace that corresponds to its destination in real space, it re-emerges. Usually, hyperdrive refers to a method of travel in which it takes a measurable amount of time to go from one point to another. When the distance is covered instantaneously, the term jump drive is often used.

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We want to thank everybody who helped us get to where we got today.

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CHAPTER 1:
Hyperspace Characteristics

While in hyperspace, spaceships are typically isolated from the normal universe; they cannot communicate with nor perceive things in real space until they emerge. Often there can be no interaction between two ships even when both are in hyperspace. To people traveling in hyperspace, time typically moves at its normal pace, with little or no time dilation; 24 hours in hyperspace equates to 24 hours in real space. This is due to the fact that typical hyperdrive scenarios involve only changing the position of the craft, without altering its velocity (i.e., a ship will emerge with the same momentum, kinetic energy and direction of travel that it had upon entering hyperspace, thereby avoiding relativistic effects). One exception is David Brin's Uplift Universe; here, hyperspace is divided into "levels" where time passes at different rates. Hyperspace itself may be portrayed as swirling colors, total blackness, featureless gray, or as something that would drive a human mind insane should it be viewed. In much science fiction, hyperdrive jumps require a considerable amount of planning and calculation, with any error carrying a threat of dire consequences. Therefore, jumps may cover a much shorter distance than would actually be possible so that the navigator can stop to "look around"—take his bearings, plot position, and plan the next jump. The time it takes to travel in hyperspace also varies. Travel times may be in hours, days, weeks or more, and in those cases can provide a setting in itself for a story that takes place during an extremely long journey.

Hyperdrive is used extensively in the StarWars universe (Figure 1.1). Remember, in space no one can hear you scream.

1.1   Enhancing Drama

Hyperdrives allow for drama in science fiction by eliminating the single biggest problem with space as a setting for a story: the vast majority of space is empty and thus more or less uninteresting. As in most depictions of hyperspace, ships with hyperdrive can typically only interact with other ships while in "normal space," they would have to drop out of hyperspace to interact, and the chance of two ships appearing at the same location in deep space to take a navigation bearing at the same time is infinitesimal. Therefore, hyperdrive ships will encounter each other most often around contested planets or space stations, which can be light-years apart.

1.1.1 Dramatic Escapes

Hyperdrive may also allow for dramatic escapes as the pilot "jumps" to hyperspace in the midst of battle to avoid destruction. Dramatic tension can also be evoked by the use of "Jump Calculations" in the same way. "Will the computer or crew be able to calculate the needed equations before being sucked into a black hole or before a group of missiles hits the ship?" Hyperspace also provides the means by which the literally astronomical distances between stars can be traversed in such a way that would enable an author to have a plot that deals with multiple star systems in a reasonable amount of time, something generally impossible if speeds less than the speed of light are observed. Authors that write about interstellar cultures without hyperdrives generally wind up with plots that last for centuries or more, something not all authors are willing to do.

1.1.2 Some Fiction

In some science fiction, hyperspace travel is portrayed as potentially dangerous due to the chance that the route through hyperspace may take the ship too close to a celestial body with a large gravitational field, such as a star, or a black hole. In such scenarios, if a starship passes too close to a large gravitational field while in hyperspace, the ship is forcibly pulled out of hyperspace and reverts to normal space, or in some stories, is destroyed. Therefore, certain hyperspace "routes" may be mapped out that are safe, not passing too close to stars or other dangers. In some science-fiction universes, such as Star Wars, artificial gravity wells may be used to force another vessel to drop out of hyperspace. Other portrayals show less interaction between normal space and hyperspace, so that ships may actually pass through the position taken up by a celestial body in real space, without being affected. Given how critical transportation is to every human cultures without hyperdrives generally wind up with plots that last for centuries or more, something not all authors are willing to do.

1.1.3 More Fiction

In some science fiction, hyperspace travel is portrayed as potentially dangerous due to the chance that the route through hyperspace may take the ship too close to a celestial body with a large gravitational field, such as a star, or a black hole. In such scenarios, if a starship passes too close to a large gravitational field while in hyperspace, the ship is forcibly pulled out of hyperspace and reverts to normal space, or in some stories, is destroyed. Therefore, certain hyperspace "routes" may be mapped out that are safe, not passing too close to stars or other dangers. In some science-fiction universes, such as Star Wars, artificial gravity wells may be

Figure 1.1: The Star Wars logo; Wikipedia says that this is public domain.

used to force another vessel to drop out of hyperspace. Other portrayals show less interaction between normal space and hyperspace, so that ships may actually pass through the position taken up by a celestial body in real space, without being affected. Given how critical transportation is to every human culture, it is unsurprising that in an interstellar culture, which must deal with distances orders of magnitude greater than terrestrial cultures, the unique ways in which interstellar travel is described in various fictional universes tends to create major plot elements in that universe.

1.2 FTL

An FTL, or "Faster Than Light," Drive is a fictional propulsion technology from the re-imagined Battlestar Galactica television series that allows space ships to achieve superluminal travel. They are fuelled by a refined version of the fictional ore tylium[**?**]. The verb jump is commonly used to describe the process of travelling via FTL drive. Dialogue states that the drive itself is "spun up" prior to use. The term FTL is never used in the original Battlestar Galactica film and television series. The term "light speed" is used, even though within the context of the storyline, the Galactica and its fleet move at sub-light speeds and are described as being unable to travel faster than light. The term FTL is also commonly used when the show is being discussed by outside parties.

1.2.1 Physics

The exact nature of the FTL drives remains unexplained in the show; what information exists has been extrapolated from visual behavior and on-screen dialogue. Little time appears to pass on a ship during a jump and objects within a ship do not appear to exhibit the signs of momentum/inertia associated with acceleration/deceleration. Nausea is a noticeable side effect noted

in some humans, for example Specialist Cally.

According to producer interviews in the season one DVD release of the series, the special effects director indicated that the FTL is a dimensional transport effect, where the ships instantaneously teleport from one place to another. This method of travel was one of several FTL ideas the production crew had in mind for the show, however to keep things simple and focused to the story, (as well as staying within budget restraints), producers David Eick and Ronald D. Moore chose the straightforward dimensional jump effect over more complex ideas. Because of this however, the term "FTL" used to describe this dimensional transition is somewhat misleading as the ships do not technically move faster than light, but rather instantaneously relocate to a new position in space without a change in speed. The fact remains, however, that they get to their destination faster than light would.

1.2.2 Navigation

Owing to difficulties navigating while using an FTL drive, ships wishing to make an FTL jump must calculate their speed, trajectory and jump duration prior to activating their FTL drive. Failure to do so can lead to ships jumping into poorly charted areas where sub-light navigation is difficult, or into dangerous areas such as those containing asteroid fields, gravity wells, or even inside a planet's atmosphere. A ship making a properly calculated jump can arrive safely in planetary orbit, or alongside other ships or spaceborne objects. Ships using the same calculations can also safely jump together. Non-calculated jumps (known as a "blind jump") are possible, as is risked by Admiral Cain aboard Pegasus during the Cylon sneak attack of the Scorpian Shipyards in the season two episode "Pegasus." In "Razor," Cain's risky jump was shown in one of Kendra Shaw's flashbacks—the ship jumped away just after undocking to the fleetyard complex while under attack by Cylon Raiders. Because little is known about the physics of the FTL drive, it is not clear whether ships must plot a course around large physical objects, such as suns and gas giants, or if they have to adjust their course to take local gravitational variations into account, although the Galactica is shown in episode "Exodus" to be capable of making a successful jump whilst travelling through the atmosphere at immense speeds towards the surface of the planet New Caprica. Jump co-ordinates must be constantly updated to allow for changes in a ship's position, and for stellar drift.

Large drives (fitted for example within a warship, such as a Battlestar and the larger civilian transports) allow them to travel greater distances than smaller craft, such as Raptors. A small ship, or ship with a less-capable FTL drive, must make several jumps in order to travel the same

Movie	Title
4	A New Hope
5	The Empire Strikes Back
6	Return of the Jedi

Table 1.1: The first set of movies. Remember, revenge is not the way of the Jedi.

Movie	Title
1	Something weird with Jar-Jar
2	I wish I could remember
3	This movie's name.

Table 1.2: The second set of movies.

distance as a larger ship. This approach can leave the craft vulnerable to detection or attack. Unlike Raptors, Vipers are not fitted with FTL drives. In order to initiate a jump, the crew must first intitiate an automated start-up procedure, known as "spinning" the FTL drive, which can take several minutes to complete. This step is done just before a planned jump, presumably because it is impractical or impossible to keep the FTL drive in a "spun up" state of readiness for an extended period of time. The Cylons are capable of calculating more accurate jumps. In "Lay Down Your Burdens," a Cylon Heavy Raider can make ten jumps in comparison to the Galactica's 500 to jump to Caprica. Because of this, smaller Cylon ships (for example a Cylon Raider) can make longer jumps than Colonial craft of a similar size. The safe limit of FTL travel for the Twelve Colonies is known as the "Red Line." A ship jumping beyond this line risks running into unknown navigational hazards, or going off course due to compound errors in its jump calculation. it Cylon technology

1.2.3 Cylon Technology

The Cylon FTL technology operated within the series is stated to be much more advanced than that operated by the Colonials, the superiority in FTL technology enables them to make much more accurate jumps of a longer range. Much like Colonial FTL technology the Cylons also make use of refined tylium ore as their fuel source. This advantage may lie primarily in the Cylon's jump computers. Using a captured unit, a squad of Galactica's Raptors were able to jump back to Caprica on a rescue mission in relatively few jumps. It is unclear whether this superior computing technology is solely responsible for the Cylon's greater range, or if there is an additional advantage in drive technology itself.

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CHAPTER 2:
Dummy Chapter

2.1 Dummy Section1

2.2 Dummy Section2

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CHAPTER 3:
Another Dummy Chapter

3.1 Dummy Section 3

3.2 Dummy Section 4

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CHAPTER 4:
Introduction to LaTeX

All kidding aside, this file `thesis.tex` is designed to show you how to use the NPS LaTeXthesis template.

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CHAPTER 5:
Introduction to LaTeX

LaTeX is a text formatting system that dates back to the 1980s. With LaTeX you create your document by editing a text input file using a program such as EMACS, `vi`, or another editor. You then give this input file to LaTeX (or, more accurately, to a program called `pdflatex`). This program then literally *compiles* your input file into a PDF file.

There are many reasons that you may wish to use LaTeX for preparing a technical report, journal article, or master's thesis:

- LaTeX allows you to directly include other files at the time that the PDF is created. This makes it easy to automatically incorporate the results of experiments or graphing programs directly into your final document, without having to retype anything.

- Because the LaTeX input file is plain ASCII, you can store your document using a source code control system such as Subversion[**?**]. This allows multiple people to work on the same document at the same time; Subversion automatically merges the changes together.

- The Bibtex bibliography system automatically maintains your citations and bibliography. The citation format is maintained separately from the citation contents, allowing you to easily change citation styles when submitting to different conferences or journals.

- Unlike Word, LaTeX gives you precise control over the placement of the text on the page. You can easily make global changes to your document and have them reflected everywhere.

- LaTeX is free software and runs on PCs, Macs, and Unix systems. This means that you can produce your documents on practically every computer you have, without having to purchase anything else.

There are many good reference books and online tutorials for LaTeXout there. The purpose of this document is not to duplicate that work, but to provide you with the minimum amount of information that you require to use LaTeX to produce a master's thesis or technical report at NPS.

5.1 Installation

Before you can use LaTeX, you will need to install two critical pieces of software:

1. The LaTeXenvironment itself.

2. A program for editing the —.tex— input files.

Here once again there are many options that you have. For both LaTeXand text editors there are both Free Open Source and commercial distributions. This document makes specific recommendations that were known to work as of the document's date of publication. You are free to explore on your own as well.

5.1.1 Installation on MacOS 10.5 and above

There are many ways to get LaTeXrunning on the Mac. The most common are:

1. Download a working installer for the most recent distribution from `http://www.tug.org/mactex`.

2. Install it from sources using `http://www.macports.org`.

3. Install it using the *i-Installer*.

Installing from TuG

TUG's MacTeX distribution will install LaTeXin the —/usr/texbin/pdflatex— directory and will update your startup files to include this directory in your path. If you chose this strategy, be sure to click "Customize" in the installer and select that all of the optional packages be installed:

Installing with MacPorts

MacPorts will download and compile the LaTeXdistribution from sources and then install it in the —/usr/local/bin— directory. This approach involes more work on your part to get going, but less work in the long run, as you can use the MacPorts system to automatically install many other open source software that might be of interest, and you can easily upgrade the installation at a later point in time.

MacPorts also requires that the Apple XCode system be installed. You should really have this installed anyway, since you need XCode to compile programs.

1. Verify that XCode is installed by opening a Terminal and typing —gcc—.

   If you see something that looks like this, you are good to go:

   ```
   $ gcc
   i686-apple-darwin10-gcc-4.2.1: no input files
   $
   ```

   If you see a "command not found" error, you need to install XCode:

   ```
   $ gcc
   -bash: gcc: command not found
   $
   ```

   You can install from your installation CD or download it from `http://developer.apple.com` (you will need to create an Apple Developer account to perform the download.)

2. Visit `http://www.macports.org` and click the Download button, which you will find in the upper-right hand corner of the website.

3. Select to download the —dmg— file.

4. Open the —dmg— file. Run and install the MacPorts package. You will need to type your password.

5. Now you need to "update" the MacPorts library, and then install the —teTeX— distribution (which includes LaTeXand several other tools). Open a Terminal window and type this command:

   ```
   # sudo port selfupdate
   # sudo port install teTeX
   ```

   You are free to download and install a tool for editing the —.tex— and —.bib— files. However, you can also edit these files using EMACS, an editor that is built-in to MacOS.

5.1.2   Installing on Ubuntu Linux or Debian Linux

Use this command:

```
% sudo apt-get install texlive-latex3
```

We have noticed that the command occasionally fails. If it does, try it again. If that still doesn't work

5.1.3   Installation on Windows

5.2   Running LaTeX

LaTeX is actually a set of programs. For creating a thesis at NPS you will use four programs:

`pdflatex` This program read the input file (*e.g.,* `thesis.tex`) and produces a PDF file (*e.g.,* `thesis.pdf`) as an output. This program also produces a number of intermediate file (`thesis.aux`, `thesis.bbl`, `thesis.toc`, *et. cetera.*)

`bibtex` This program reads the `thesis.bbl` file and produces a bibliography in a file called `thesis.bst` which includes the bibliography. The `thesis.bst` then gets read the next time `pdflatex` is run.

`authorindex.pl` a program in perl that produces the author index from the `thesis.bbl` file. The authorindex is saved in the file `thesis.ain`.

`fixbbl.py` It turns out that there is a bug in BibTeX which causes URLs longer than 53 characters to be improperly split. This program unsplits them.

Normally you would run LaTeX with a three step process:

- `pdflatex thesis`

- `bibtex thesis`

- python fixbbl.py thesis

-

- `pdflatex thesis`

- `pdflatex thesis`

5.3 Basic LaTeX

Here is a simple document:

```
\documentclass{article}
\begin{document}
Hello World!
\end{document}
```

Normally with LaTeX you just type text. Leave a blank line between each paragraph. LaTeX then formats it into beautiful paragraphs. LaTeX will ignore the space at the beginning of each line.

So if you type this:

```
In December 1951, in a move virtually unparalleled in the history of
academe, the Postgraduate School moved lock, stock and wind tunnel
across the nation, establishing its current campus in Monterey,
Calif. The coast-to-coast move involved 500 students, about 100
faculty and staff and thousands of pounds of books and research
equipment. Rear Adm. Ernest Edward Herrmann supervised the move that
pumped new vitality into the Navy's efforts to advance naval science
and technology.
```

LaTeX will format it to look like this:

> In December 1951, in a move virtually unparalleled in the history of academe, the Postgraduate School moved lock, stock and wind tunnel across the nation, establishing its current campus in Monterey, Calif. The coast-to-coast move involved 500 students, about 100 faculty and staff and thousands of pounds of books and research equipment. Rear Adm. Ernest Edward Herrmann supervised the move that pumped new vitality into the Navy's efforts to advance naval science and technology.

5.3.1 Typing Quotes

To type quotes, you should not use the double-quote character. Instad, LaTeXuses the back quote
(`) and the forward quote (') to type quotes.

To get this	type this
don't	`don't`
3'2"	`3'2''`
"this"	`''this''`
'is'	`'is'`
"'special'"	`''\,'special'\,''`

The last one is a bit confusing, but don't worry, everything will make sense in a bit.

5.3.2 Special Characters

Unlike Microsoft Word and other programs, LaTeXuses special characters embedded in your text
to control formatting. The most common of these characters is the backslash (\). To produce
each of these characters you must use a special sequence that begins, strangely enough, with a
backslash.

The table below shows the ten special characters.

To get this	type this	To get this	type this
$	`\$`	&	`\&`
{	`\{`	}	`\}`
%	`\%`	_	`\_`
#	`\#`	^	`\^{}`
~	`\~{}`	\	`$\backslash$`

The good news is that you typically don't need these characters very much when preparing
technical documents.

5.3.3 Accented Vowels

For the most part LaTeXbuilds accented vowls by combining an accent character with a vowel:

To get this	Type this	To get this	type this
ó	\'{o}	õ	\~{o}
ó	\'{o}	ō	\={o}
ô	\^{o}	ȯ	\.{o}
ö	\"{o}	ǫ	\d{o}
ǫ	\c{o}	ŏ	\u{o}
o̲	\b{o}		

However, there are some special accented characters that are just specials:

To get this	Type this		
å	\aa	Å	\AA

Sometimes you will need to use dotless characters. You can get them with these sequences:

ı	\i	ȷ	\j
ø	\o	Ø	\O

These sequences will give you slashes and daggers:

ł	\l	Ł	\L
†	\dag	ß	\ss
¶	\P	£	\pounds

5.3.4 Special Characters

type this	To get this	type this	To get this
¿	?`	©	\copyright
œ	\oe	Œ	\OE
¡	!`	§	\S
ǒ	\v{o}	ő	\H{o}
o͡o	\t{oo}	æ	\ae
Æ	\AE	ł	\l
†	\dag	¶	\P
ß	\ss	Ł	\L
‡	\ddag	£	\pounds

5.3.5 Changing font size

Command	Example
`\tiny`	this is 6 point font
`\scriptsize`	8
	10
	11
	12
	14
	17
	20
	25
	25

5.3.6 Changing font style

Command	Example
Roman	
This is bold	
`This is typewriter`	
THIS IS SMALL CAPITALS	
This is slanted	
Itallics	
This is emphasized	
$\mathcal{CALLIGRAPHIC}$	
$\boldsymbol{\mathcal{BOLDCALIGRAPHICS}}$	

5.3.7 choosing an arbitrary font

5.3.8 Controlling Spaces

Use:

`\,` (a slash followed by a comma) to produce a small space. `\` (a slash followed by a space) to produce a standard word space `\@` (a slash followed by an at sign) to produce a standard intersentence space.

Type this	To get this
` ``One Way'' `	"One Way"

5.3.9 Controlling Line Breaks

You can force a blank line with: \\

Like this:

This is
a test

You can insert an arbitrary amount of space with the optional argument:

This is
a test

You can add or remove space on a page with \enlargethispage. For example, to squeeze a second line, try this:

```
\enlargethispage{1pc}
```

You can insert verticale or horizontal space (or take it away) with

\vspace{1in} \hspace{1in}

You can draw a box around text with:

\framebox[width]{textstring}

The width is optional.

Centering:

This is centered.

5.3.10 Lists

There are three kinds of lists that you may wish to make:

description lists are used for definitions (like this).

enumerated lists are lists where each item is numbered and the ordering is relevant, like the steps of a recipe.

itemized lists are lists where each item is of equal importance.

Lists are implemented as LATEXenvironments, which means that they begin with a `\begin{`*listname*`}` and end with an `\end{`*listname*`}`.

```
\begin{enumerate}
\item Wake up.
\item Go to work.
\item Go home.
\item Go to sleep.
\item Repeat.
\end{enumerate}
```

1. Wake up.
2. Go to work.
3. Go home.
4. Go to sleep.
5. Repeat.

5.3.11 Tables

5.3.12 Math

5.3.13 Graphics

This section briefly describes graphics and LATEX. For alternative treatments we recommend Höppner's "Strategies for including graphics in LATEXdocuments"[**?**], and the book TK.

There are many graphic file formats and practically all of them can be embedded within a LATEXdocument. Unfortunately, including graphics is complicated by the fact that there are two flavors of LATEXand they both require different graphic file inputs.

There are two kinds graphics that you can include in a LATEXdocument: vector graphics and bitmaps:

Vector graphics are graphical objects that contain commands for rendering an illustration— the graphic describes *how* something is to be drawn. Typical examples of vector graphics are text and

5.4   BiBTeX

CHAPTER 6:
The NPS Thesis Template

Now that you know the basis of LaTeX, this chapter will give you information on how to typeset your thesis with the NPS thesis template.

6.1 Getting LaTeX

Get a copy of the `npsthesis.tar.gz` distribution from `http://faculty.nps.edu/slgarfin/npsthesis.tar.gz`. Unpack this into a directory on your computer; Table 6.1 shows the important files that you will fine.

`Makefile`	The Makefile to make the thesis
`authorindex.*`	The LaTeXauthorindex package, for making the Referenced Authors page.
`chngcntr.sty`	The `chngcntr` package, for changing the way that LaTeXdisplays its counters.
`fixbbl.py`	A python program that removes the breaks in the `.bbl` file inserted by BibTex.
`nps-plain.bst`	A BibTex style file that makes references in a style that is acceptable to NPS.
`nps-plain-unsorted.bst`	A BibTex style file that makes references in a style that is acceptable to NPS.
`nps-plain-classified.bst`	A BibTex style file that makes references in a style that is acceptable to NPS.
`nps-plain-classified-unsorted.bst`	A BibTex style file that makes references in a style that is acceptable to NPS.
`nps_logo_3clr_cymk.pdf`	NPS Logo, 3 color
`nps_logo_black_cymk.pdf`	NPS Logo, black and white
`thesis.bib`	Your thesis bibliography file
`thesis.tex`	Your thesis LaTeXsource

Table 6.1: Files included with your distribution.

To create your thesis, start with the file `thesis.tex`. `thesis.bib`

6.2 Tables and Figures

Tables and figures are floating objects that LaTeXmoves around as necessary to make your thesis look better. Tables are inserted with the `\begin{table}` command while figures are inserted with `\begin{figure}`. Here are some rules to consider:

- Every table and figure should have a caption, created with the `\caption{text}` command.

- Every table and figure should have a unique label, created with the `\label{marker}` command.

\chapref	Chapter reference that formats as "Chapter 3"
\chapvref	Chapter reference that formats as "Chapter 3 on page 4"
\secref	Section reference that formats as "Section 3." You can use this for sections, subsections, and so on.
\secvref	Section reference that formats as "Section 3 on page 4"
\figref	Figure reference that formats as "Figure 3"
\figvref	Figure reference that formats as "Figure 3 on page 4"
\tabref	Table reference that formats as "Table 3"
\tabvref	Table reference that formats as "Table 3 on page 4"
\appref	Appendix reference that formats as "Appendix 3"
\appvref	Appendix reference that formats as "Appendix 3 on page 4"

Table 6.2: Reference commands included in the `thesis.tex` demo file.

Figure 6.1: Banner from the top of the NPS web site

- Every table and figure should be referred to in the main body of your text. LATEXprovides a command called \ref{marker}; this template provides additional commands \tabref{marker} and \figref{marker}. All of the reference commands are shown in Table 6.2.

- Do not assume that figures will be on the same text as your page. Always refer to the

6.3   Including Photos and Figures

This section shows how you can easily include photos.

Using the \sgraphic{filename}{caption} command you bring in a photo from a given filename and give it a caption. The filename is then automatically set up as LATEXcross-reference. Use the \figref{tag} command to get an in-paragraph reference. Figure 6.1 shows an example of this.

The \twofigures{width1}{image1}{caption1}{width2}{image2}{caption2} macro allows you to have two figures side-by-side, as shown in Figure 6.2 and Figure **??**.

There are a large number of these layout macros at the end ofnpsthesis.cls — give them a look!

Figure 6.2: A photo from the NPS web site

Figure 6.3: A second photo from the NPS web site.

6.4   Going Further

If you are interested, feel free to review the file `npsthesis.cls`. A great deal of effort has gone into making this file both readable and understandable. You will find additional commands in this file and you may even have thoughts on changes to make. Please let us know what you come up with!

You may find the following packages useful:

`multirow` – Allows a single table cell to extend to multiple rows. `ifthen` — allows you to put conditions in your thesis. It's a bit easier than using the `if` that's built in to TEX.

REFERENCES

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