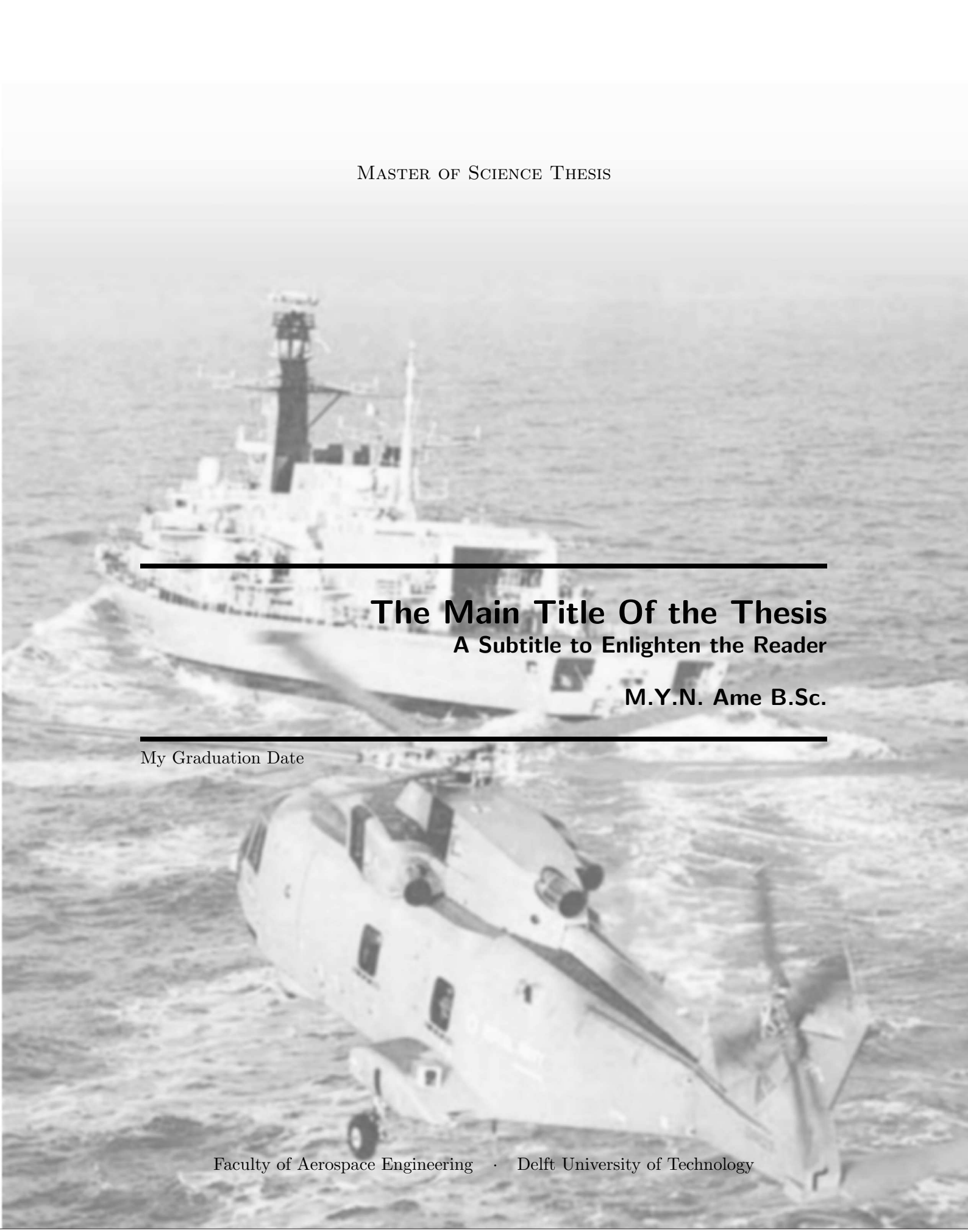
Master of Science Thesis



The Main Title Of the Thesis

A Subtitle to Enlighten the Reader

M.Y.N. Ame B.Sc.

My Graduation Date

Faculty of Aerospace Engineering · Delft University of Technology

TU Delft Delft University of Technology

Challenge the future

The Main Title Of the Thesis
A Subtitle to Enlighten the Reader

Master of Science Thesis

For obtaining the degree of Master of Science in Aerospace Engineering at Delft University of Technology

M.Y.N. Ame B.Sc.

My Graduation Date

Faculty of Aerospace Engineering · Delft University of Technology

Delft University Of Technology
Department Of
Design, Integration and Operations of Aircraft and Rotorcraft

The undersigned hereby certify that they have read and recommend to the Faculty of Aerospace Engineering for acceptance a thesis entitled **"The Main Title Of the Thesis"** by **M.Y.N. Ame B.Sc.** in partial fulfillment of the requirements for the degree of **Master of Science**.

Dated: My Graduation Date

Head of department: _____
prof.dr.ir. P.R. Of

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ir. Reader Four

Summary

This is the summary of the thesis.

Acknowledgements

I wish to thank the following persons...

Delft, The Netherlands
My Graduation Date

M.Y.N. Ame B.Sc.

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Nomenclature

Latin Symbols

m	mass	$[kg]$
$\dot{m}$	mass flow	$[kg/s]$
$\bar{x}$	State vector of a dynamical system	$[-]$

Greek Symbols

γ	flight path angle	$[rad]$
δ	some coefficient to show proper sorting of symbols	$[-]$
α	This is a very long explanation, and without this, it is still too short to show you what I want to show...	$[rad]$
θ	Angle of pitch	$[rad]$
ϕ	Flight path angle	$[rad]$

Subscripts

$_i$	An index, or something...

Superscripts

^{2}	Square me

Abbreviations

PD	Proportional – Derivative (Controller)
PID	Proportional – Integral – Derivative (Controller)
P	Proportional (Controller)

Other Symbols

[ ]	matrix
$\bar{}$	vector quantity
{ }	column vector

Chapter 1

Introduction

1.1 Before You Start

RTFM[1]: The Not So Short Introduction to LaTeX 2_ε. Chapters 1, 2 and 3 are a must.

And you directly see why LaTeX is so much easier than Word, external references actually work.

1.2 Quick Compilation of Your Thesis

To quickly compile your thesis without processing all figures, add `draft` to the list of optional arguments of the main file (`my_thesis.tex` in this case):

```
\documentclass[draft]{dutmsc}%
```

The actual figures will not appear, only a border will be shown. This reduces the compilation time by a significant amount. The command `\includeonly{filelist}` can also be used to only process the chapter you are working on at the time.

1.3 Custom Commands

1.3.1 Vertical Spacing in Tables

Look at Table 1.1. Iz nice, no? It uses two custom commands to add some space just after (bottom) and before (top) a horizontal line, `\B` and `\T`. Without them, the table would look really bad (see Table 1.2).

[1] Read The Fabulous Manual ;-)

Param	Value	Unit
v_i	11.47	$[m/s]$
ΩR	212.25	$[m/s]$
λ_i	0.054	$[-]$

Table 1.1: Improved vertical spacing in tables

Param	Value	Unit
v_i	11.47	$[m/s]$
ΩR	212.25	$[m/s]$
λ_i	0.054	$[-]$

Table 1.2: Default vertical spacing in tables

1.3.2 Shorthand Notations for Sine, Cosine and Tangent

Three commands are available to display sine, cosine and tangent of angles in math mode: $\mathcal{C}_\alpha$, $\mathcal{S}_\beta$, $\mathcal{T}_\gamma$.

1.4 Bibliography/References

These are some references just for the sake of it. If you want to know more about ground effect models, consult [3]. For an introduction into helicopter aerodynamics, read [2]. And a reference to LAPACK [1]. If you need to know more about the display options for citations, read the documentation that is provided in its manual `./local/apacite/apacite.pdf`.

This thesis uses a bib-file (named `biblio.bib`), which contains a database of references. LaTeX collects those references that were referred to in the thesis, and store them in the `*.aux` files (for this chapter in `chap_introduction.aux`). And as long a the program `bibtex` is not executed, LaTeX will complain about undefined citations and a missing `.bbl` file (in this case `my_thesis.bbl`). To solve this, execute `bibtex`. If everything goes as it should, a `my_thesis.bbl` is created, and the next time you run LaTeX, a section with references will appear.

Using `Kile` (on Linux), BibTex can be executed from the `Build -> Compile -> Bibtex` menu, or using the shortcut `ALT+-` (as in ALT+minus).

Using `TeXnicCenter`, BibTex can be executed from the `Build -> BibTex` or `Build -> Current File -> BibTex` menu.

Using `WinEdt`, BibTex can be executed with the shortcut `CTL+SHIFT+B` or from the menu `Accessories -> BibTex`.

1.5 Symbols and Units

For symbols, we use the `nomencl` package, of which you need the latest version (version 4.2, dated 2005/09/22).

1.5.1 Summary of Commands

For nomenclature (symbols and abbreviations) to appear in the nomenclature chapter, the following 6 categories are available:

Latin Symbols `\lsymb[t]{symbol}{description}{unit}{sortsymbol}`

Greek Symbols `\gsymb[t]{symbol}{description}{unit}{sortsymbol}`

Other Symbols `\osymb[f]{symbol}{description}{sortsymbol}`

Superscripts `\subscr[f]{symbol}{description}`

Subscripts `\superscr[f]{symbol}{description}`

Abbreviations `\acron[f]{abbreviation}{description}`

The first option (with the square brackets) is an optional argument that lets you control the appearance of the symbol in the text at the place where the command appears. If it is equal to *t*, the symbol will appear in the text and in the nomenclature list and otherwise, it will only appear in the nomenclature list. By default, Greek and Latin symbols will appear in the text, even if the optional symbol is not set. In case they should not appear, you have to add `[f]` as first argument. In the above list, the default values are given, so by default, only the Greek and Latin symbols will appear in the text at the place where the commands appear.

Now, if you want these symbols to appear in the *Nomenclature list*, execute `makeindex`[2]:

```
makeindex $THESIS_NAME.nlo -s nomencl.ist -o $THESIS_NAME.nls
```

where `$THESIS_NAME` is the name of the main file (without extension), in this case `my_thesis`. Depending on the editor you use, it may not be necessary to resort to command line magic, you might just have to press a button that defines a macro. Another solutions is to use the *bat* file included in the same directory: `sort_symb.bat`. Executing this should do the above automagically.

Sorting Symbols

To sort symbols properly, an additional fourth mandatory argument is added to the Greek, Latin and Other symbols. These add the ability to sort similar symbols (such as $\dot{m}$ and m) in the proper order (m before $\dot{m}$). The way to make sure that the symbol for mass flow appears after the symbol for mass is shown below:

```
\lsymb[t]{$m$}{mass}{$[kg]$}{mm}
\lsymb[t]{$\dot{m}$}{mass flow}{$[kg/s]$}{mz}
```

[2]Note that makeindex is a program on your computer. It is not a LaTeX command!

`mz` comes after `mm` when sorted by `makeindex`, which means that the symbol of mass flow will be put after the symbol for mass.

Something similar can be done for the Greek symbols. If γ (third letter in the Greek alphabet) should appear before δ (fourth letter), add a letter to force proper sorting:

```
\gsymb[t]{$\gamma$}{flight path angle}{$[rad]$}{cc}
\gsymb[t]{$\delta$}{some coefficient to show proper sorting of symbols}{$[-]$}{4}
```

In table 1.3, you can find the sort symbols (index) that I used to make sure that the Greek symbols appear in the correct order in the nomenclature.

Greek Symbol	Command	Index	Greek Symbol	Command	Index
α	`\alpha`	aa	o	`o`	oo
β	`\beta`	bb	Π	`\Pi`	p
Γ	`\Gamma`	c	π	`\pi`	pp
γ	`\gamma`	cc	ρ	`\rho`	qq
Δ	`\Delta`	d	Σ	`\Sigma`	r
δ	`\delta`	dd	σ	`\sigma`	rr
ϵ	`\epsilon`	ee	τ	`\tau`	ss
ζ	`\zeta`	ff	Υ	`\Upsilon`	t
η	`\eta`	gg	υ	`\upsilon`	tt
Θ	`\Theta`	h	Φ	`\Phi`	u
θ	`\theta`	hh	ϕ	`\phi`	uu
ι	`\iota`	ii	χ	`\chi`	vv
κ	`\kappa`	jj	Ψ	`\Psi`	w
Λ	`\Lambda`	k	ψ	`\psi`	ww
λ	`\lambda`	kk	ω	`\omega`	xx
μ	`\mu`	ll	Ω	`\Omega`	x
ν	`\nu`	mm			
Ξ	`\Xi`	n			
ξ	`\xi`	nn			

Table 1.3: Sort symbols used to sort all Greek letters

1.5.2 More Examples

The angle of attack (`\gsymb[f]{\alpha}{Angle of attack}{$[rad]$}{aa}`) can be calculated from the pitch angle θ (`\gsymb{\theta}{Angle of pitch}{$[rad]$}{hh}`) and the flight path angle ϕ (`\gsymb{\phi}{Flight path angle}{$[rad]$}{uu}`) as follows:

$$\alpha = \theta + \phi \tag{1.1}$$

Same thing for Latin symbols:

$\bar{x}$, for which the code looks like this:

[3] Note that the sign depends on the definition of the angles.

```
\lsymb[t]{$\bar{x}$}{State vector of a dynamical system}{$[-]$}{xb}
```

$$\bar{x}^2 = \theta_i \tag{1.2}$$

For subscripts and superscripts (as depicted in Eq 1.2), something special is needed. The sub- and superscripts must be added separately, as in:

```
\superscr[f]{2}{Square me}\subscr{i}{An index, or something\ldots}
```

The commands for sub- and superscripts also have only two obligatory arguments, instead of three as is the case with the Latin and Greek symbols.

Acronyms are also part of the nomenclature list. They are defined as follows:

```
\acron[t]{PID}{Proportional -- Integral -- Derivative}
```

P, PD and PID controllers.

At last, there is a possibility for other symbols that do not fit in any of the above categories, such as symbols to denote matrices or vector quantities, such as [ ] { }nd ¯

1.6 Figures

Up to version 1.0.7 of the style file, the only option to generate pdf output was throught the three-step process LATEX → DVI, DVI → PS, PS → PDF.

Starting from version 1.0.8, direct pdf output is supported as well. This has some consequences for the file formats of figuress that are supported. When creating the pdf directly, figures in (encapsulated) postscript format will give errors. Convert them to pdf format.

In all previous versions of this document, the advice in this section was to save all plots and figures as PostScript, and not as PDF. Processing your LaTeX input using LATEX → DVI, DVI → PS, PS → PDF works without problems. An added benefit is that you can use the *psfrag* package to replace ordinary text characters in the postscript figures by e.g. mathematical formulas typeset in LaTeX. Also, one can use the *pstricks* packages to create figures (see PSTricks packages) directly in LaTeX.

The same can be achieved with plot output from e.g. MATLAB using *LaPrint*.

LaPrint is a MATLAB function to print MATLAB graphics for inclusion in LaTeX documents. LaPrint creates an eps-file and a tex-file. The tex-file contains the annotation of the figure such as titles, labels and texts. The eps-file contains the non-text part of the figure and is called by the tex-file.

The main advantage of using LaPrint is that the annotation can be neatly (e.g., including math mode and fancy font constructs) set within LaTeX. LaPrint can be used from the command line or via a graphical user interface (GUI).

A Users Guide for LaPrint is available at `http://www.uni-kassel.de/fb16/rat/matlab/laprint/laprintdoc.ps`. The m-file can be downloaded from Matlab File Exchange.

1.6.1 Some Examples

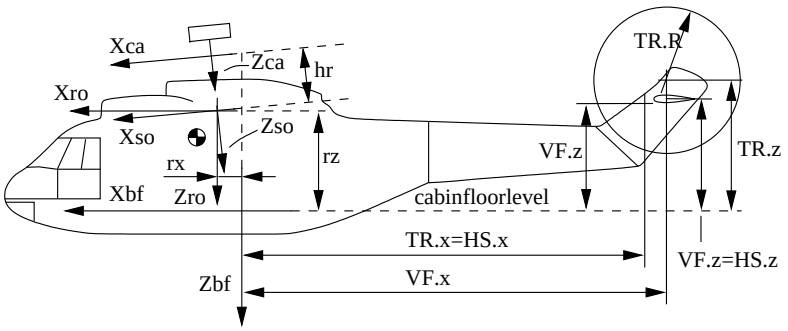

Figure 1.1: Schematic sideview of a helicopter that is by now most likely too long to fit on one line.

And a fancy figure to show you what is possible with graphics in LaTeX, see Figure **??**.

1.6.2 Alternatives

An alternative to saving figures as PostScript is saving them as PDF. Then, you have to use *pdflatex* which skips the intermediate files. Please note that I will not provide support if you run into problems when you decide to do it this way.

References

[1] LAPACK – Linear Algebra PACKage. http://www.netlib.org/lapack/, July 2006.

[2] J. G. Leishman. *Principles of Helicopter Aerodynamics*. Cambridge Aerospace Series. Cambridge University Press, Cambridge, 2002.

[3] H. Xin. *Development and Validation of a Generalized Ground Effect Model for Lifting Rotors*. Ph.D. Thesis, Georgia Institute of Technology, Georgia, Atlanta, 1999.

Appendix A

Mathematical Model

A.1 Introduction

This appendix contains the math model of the thesis. It looks as follows:

$$c = \sqrt{a^2 + b^2} \tag{A.1}$$