

L^AT_EX Thesis Template
of
The University of Waterloo

by

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The following served on the Examining Committee for this thesis. The decision of the Examining Committee is by majority vote.

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Author's Declaration

I hereby declare that I am the sole author of this thesis. This is a true copy of the thesis, including any required final revisions, as accepted by my examiners.

I understand that my thesis may be made electronically available to the public.

Abstract

This is a short brochure on how to write your thesis by using this \LaTeX template. It's easy, efficient and straightforward. What you need to do, no matter you are familiar with \LaTeX or not, is to have a try.

Acknowledgements

I owe my deepest gratitude and appreciation to my doctoral advisors: Dr. Fue-Sang Lien, Dr. Fan Zhang, and Dr. Duane Cronin. Dr. Fue-Sang Lien has always been supportive, approachable, and helpful throughout my doctoral study. His encouragement and understanding helped me go through the difficulties and created the space for me to develop research ideas. Working with Dr. Fan Zhang has been the most amazing experience in my life. I have always been fascinated by his insights on physics and the ability to instantly and accurately identify the key problems based on a set of fragmented information. His keen and open-minded guidance inspired my interests in the field of my doctoral study, shaped my critical thinking, and challenged me to be a higher level thinker. It was an enlightening and enriching experience to collaborate with Dr. Duane Cronin. Whenever I needed advice, he was ready and patient to help. He was always kind to teach me and willing to share his experience and vision on how to be a professional, rigorous, and persuasive researcher. The moments I interacted with and the knowledge I learned from my outstanding advisors will be remembered by me throughout the rest of my life.

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I would like to thank the official members of my examining committee for their efforts in reviewing my thesis and providing helpful suggestions. In addition, I want to express my gratitude to Dr. Jean-Pierre Hickey for his kind help with my teaching practice, to Dr. Cecile Devaud for her helpful comments on my comprehensive examination report, to Dr. Lilia Krivodonova for her thoughtful teaching on numerical solutions of partial differential equations, and to Dr. Luc Bauwens for taking his time to come and attend my examination in person. I also want to thank my colleagues in the Energy Research Center for their support and discussions and the faculty and staff in the Mechanical and Mechatronics Engineering department for their assistance and help throughout my doctoral study. Finally, I am indebted to my family for their continuous support and understanding with my pursuit of scientific research.

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List of Tables

Nomenclature

Characters

Symbol	Description	Unit
R	specific gas constant	$\text{m}^2 \cdot \text{s}^{-2} \cdot \text{K}^{-1}$
C_v	specific heat capacity at constant volume	$\text{m}^2 \cdot \text{s}^{-2} \cdot \text{K}^{-1}$
C_p	specific heat capacity at constant pressure	$\text{m}^2 \cdot \text{s}^{-2} \cdot \text{K}^{-1}$
e_T	specific total energy	$\text{m}^2 \cdot \text{s}^{-2}$
e	specific internal energy	$\text{m}^2 \cdot \text{s}^{-2}$
h_T	specific total enthalpy	$\text{m}^2 \cdot \text{s}^{-2}$
h	specific enthalpy	$\text{m}^2 \cdot \text{s}^{-2}$
k	thermal conductivity	$\text{kg} \cdot \text{m} \cdot \text{s}^{-3} \cdot \text{K}^{-1}$
T	temperature	K
t	time	s
p	thermodynamic pressure	$\text{kg} \cdot \text{m}^{-1} \cdot \text{s}^{-2}$
\hat{p}	hydrostatic pressure	$\text{kg} \cdot \text{m}^{-1} \cdot \text{s}^{-2}$
f_b	body force	$\text{kg} \cdot \text{m}^{-2} \cdot \text{s}^{-2}$
S	boundary surface	m^2
Ω	spatial domain	m^3
V	velocity vector	$\text{m} \cdot \text{s}^{-1}$
u	x component of velocity	$\text{m} \cdot \text{s}^{-1}$
v	y component of velocity	$\text{m} \cdot \text{s}^{-1}$
w	z component of velocity	$\text{m} \cdot \text{s}^{-1}$
c	speed of sound	$\text{m} \cdot \text{s}^{-1}$
x	position vector	m
\mathbf{n}	unit outward normal vector	1
$\hat{\mathbf{t}}$	unit tangent vector	1

$\tilde{\mathbf{i}}$	unit bitangent vector	1
C_R	coefficient of restitution	1
Re	Reynolds number	1
Pr	Prandtl number	1
Ma	Mach number	1
α	thermal diffusivity	$\text{m}^2 \cdot \text{s}^{-1}$
μ	dynamic viscosity	$\text{kg} \cdot \text{m}^{-1} \cdot \text{s}^{-1}$
ν	kinematic viscosity	$\text{m}^2 \cdot \text{s}^{-1}$
γ	heat capacity ratio	1
ρ	density	$\text{kg} \cdot \text{m}^{-3}$
U	vector of conservative variables	
F	vector of fluxes	
Φ	vector of source terms	
σ	stress tensor	$\text{kg} \cdot \text{m}^{-1} \cdot \text{s}^{-2}$
\mathbf{S}	deviatoric stress tensor	$\text{kg} \cdot \text{m}^{-1} \cdot \text{s}^{-2}$
τ	viscous stress tensor	$\text{kg} \cdot \text{m}^{-1} \cdot \text{s}^{-2}$
δ	Kronecker tensor	1
\mathbf{I}	identity tensor	1

Operators

Symbol	Description
O	order of magnitude
Δ	difference
∇	gradient operator
δ^\pm	upwind-biased interpolation scheme
δ^0	central interpolation scheme

Abbreviations

Acronym	Description
ANFO	Ammonium Nitrate Fuel Oil
CFD	Computational Fluid Dynamics
CFL	Courant–Friedrichs–Lewy

CJ	Chapman–Jouguet
EOS	Equation of State
JWL	Jones–Wilkins–Lee
TVD	Total Variation Diminishing
SSP	Strong Stability Preserving
WENO	Weighted Essentially Non-oscillatory
ZND	Zel’dovich–von Neumann–Doering

Chapter 1

A Brief Guide

1.1 What is L^AT_EX

L^AT_EX (pronounced "Lah-tech" or "Lay-tech") is a macro package created by Leslie Lamport based on T_EX. As a document preparation system for high-quality typesetting in almost any forms of publishing, L^AT_EX is not the name of a particular editing program, but refers to the encoding or tagging conventions that are used in L^AT_EX documents [1, 2]. The best resource to learn L^AT_EX is "L^AT_EX Wikibook", which is available online.

1.2 Why use L^AT_EX?

There are a lot of good reasons why you need to use L^AT_EX, the most significant one is the following:

- Allows you to clearly separate the content from the format of your document.
- Let you concentrate on your ideas, not visual appearance.

You can concentrate purely on the structure and contents of your document, not superficial layout issues. You don't need to manually adjust fonts, text sizes, line heights, or text flow for readability, as L^AT_EX takes care of them automatically. [3]

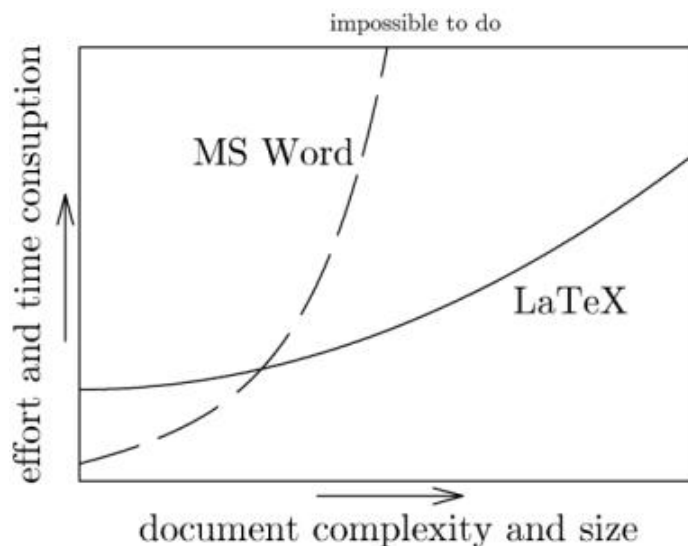


Figure 1.1 Comparison between Microsoft Word and L^AT_EX [From Google Images]

1.3 How to use?

1.3.1 Installation

LaTeX is based on open-source code, so it is available on most computing platforms as free software. If encounter some compiling problems after installation, please Google it. For example, MikTeX may complain about "mathtools.sty", a solution given on "StackExchange" is "The problem is that the package manager has somehow "desynchronized" (even though it's a fresh install). To fix it, run MikTeX Package Manager as administrator—"Package Manager (Admin)". Go to Repository—Synchronize. When that completes, your TexWorks should automatically find the needed style files again."

- Linux: TeXLive distribution.
- MacOS: Mactex or TeXLive.
- Windows: MikTeX or TeXLive.

Note: to use L^AT_EX, you need a text editor for writing and editing ".tex" files. To open the ".tex" files in this template, you need a text editor which supports "UTF-8" encoding. Free options for different platforms are the following:

- Linux: vim.
- MacOS: TeXShop, Macvim.
- Windows: Texmaker, Gvim, Notepad++.

1.3.2 Include math

L^AT_EX realization of Equation 1.1 is something like this:

$$\begin{cases} \frac{\partial \rho}{\partial t} + \nabla \cdot (\rho \mathbf{V}) = 0 \\ \frac{\partial(\rho \mathbf{V})}{\partial t} + \nabla \cdot (\rho \mathbf{V} \mathbf{V}) = \nabla \cdot \boldsymbol{\sigma} \\ \frac{\partial(\rho E)}{\partial t} + \nabla \cdot (\rho E \mathbf{V}) = \nabla \cdot (k \nabla T) + \nabla \cdot (\boldsymbol{\sigma} \cdot \mathbf{V}) \end{cases} \quad (1.1)$$

$$\frac{\partial}{\partial t} \int_{\Omega} u \, d\Omega + \int_S \mathbf{n} \cdot (u \mathbf{V}) \, dS = \dot{\phi} \quad (1.2)$$

$$\mathcal{L}\{f\}(s) = \int_{0^-}^{\infty} f(t) e^{-st} \, dt, \quad \mathcal{L}\{f\}(s) = \int_{0^-}^{\infty} f(t) e^{-st} \, dt$$

$$\mathcal{F}(f(x+x_0)) = \mathcal{F}(f(x)) e^{2\pi i \xi x_0}, \quad \mathcal{F}(f(x+x_0)) = \mathcal{F}(f(x)) e^{2\pi i \xi x_0}$$

mathtext: $A, F, L, 2, 3, 5, \sigma$, mathnormal: $A, F, L, 2, 3, 5, \sigma$, mathrm: $A, F, L, 2, 3, 5, \sigma$.

mathbf: $\mathbf{A}, \mathbf{F}, \mathbf{L}, \mathbf{2}, \mathbf{3}, \mathbf{5}, \sigma$, mathit: $A, F, L, 2, 3, 5, \sigma$, mathsf: $A, F, L, 2, 3, 5, \sigma$.

mathtt: $A, F, L, 2, 3, 5, \sigma$, mathfrak: $\mathfrak{A}, \mathfrak{F}, \mathfrak{L}, 7, 8, , \sigma$, mathbb: $\mathbb{A}, \mathbb{F}, \mathbb{L}, \neq, \neq, \neq, \sigma$.

mathcal: $\mathcal{A}, \mathcal{F}, \mathcal{L}, \in, \ni, \nabla, \sigma$, mathscr: $\mathcal{A}, \mathcal{F}, \mathcal{L}, , , , \sigma$, boldsymbol: $\mathbf{A}, \mathbf{F}, \mathbf{L}, \mathbf{2}, \mathbf{3}, \mathbf{5}, \sigma$.

vector: $\boldsymbol{\sigma}, \mathbf{T}, \mathbf{a}, \mathbf{F}, \mathbf{n}$, unitvector: $\boldsymbol{\sigma}, \mathbf{T}, \mathbf{a}, \mathbf{F}, \mathbf{n}$

matrix: $\boldsymbol{\sigma}, \mathbf{T}, \mathbf{a}, \mathbf{F}, \mathbf{n}$, unitmatrix: $\boldsymbol{\sigma}, \mathbf{T}, \mathbf{a}, \mathbf{F}, \mathbf{n}$

tensor: $\boldsymbol{\sigma}, \mathbf{T}, \mathbf{a}, \mathbf{F}, \mathbf{n}$, unittensor: $\boldsymbol{\sigma}, \mathbf{T}, \mathbf{a}, \mathbf{F}, \mathbf{n}$

1.3.3 Include Graphics

Note: including figures may seem to be scary by looking at the codes. However, the fact is that you only need to modify the names in each part, the rest are simply copy and paste. These codes are all available in the file "Useful Commands.txt".

Figure 1.2 is an example for including a single figure.

```
\begin{figure}[!htbp]
  \centering
  \includegraphics[width=0.45\textwidth]{oaspl_a}
  \caption{An Example for including a single figure}
  \label{fig:oas}
\end{figure}
```

Figure 1.3 is an example for including multiple figures.

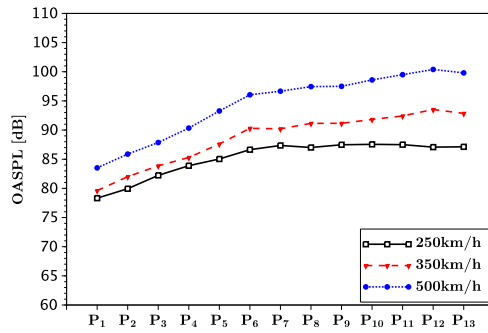
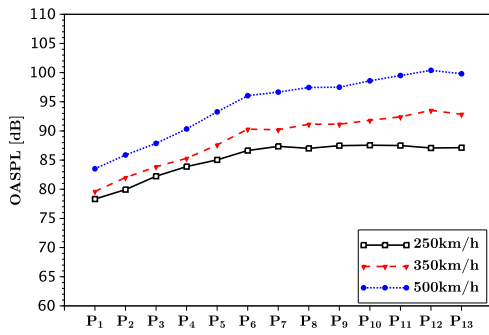


Figure 1.2 An Example for including a single graph

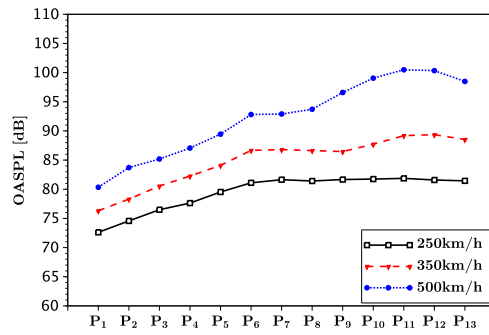
```

\begin{figure}[!htbp]
  \centering
  \begin{subfigure}[b]{0.45\textwidth}
    \includegraphics[width=\textwidth]{oaspl_a}
    \caption{}
    \label{fig:oaspl_a}
  \end{subfigure}%
  ~% add a small space
  \begin{subfigure}[b]{0.45\textwidth}
    \includegraphics[width=\textwidth]{oaspl_b}
    \caption{}
    \label{fig:oaspl_b}
  \end{subfigure}%
  \\% change line
  \begin{subfigure}[b]{0.45\textwidth}
    \includegraphics[width=\textwidth]{oaspl_c}
    \caption{}
    \label{fig:oaspl_c}
  \end{subfigure}%
  ~% add a small space
  \begin{subfigure}[b]{0.45\textwidth}
    \includegraphics[width=\textwidth]{oaspl_d}
    \caption{}
    \label{fig:oaspl_d}
  \end{subfigure}%
  \caption{An Example for including multiple figures}
  \label{fig:oaspl}
\end{figure}

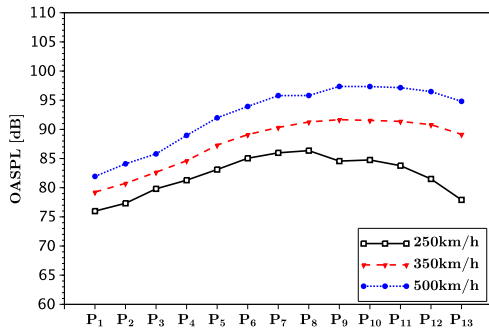
```

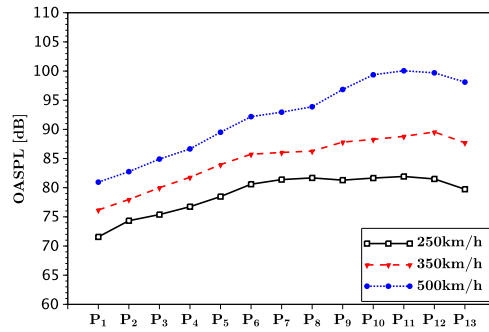
(a)



(b)



(c)



(d)

Figure 1.3 An Example for including multiple figures

1.3.4 Include a citation

Suppose you are going to cite an article named "Document Preparation System", the procedures are:

- Use Google Scholar search "Document Preparation System".
- Open "Cite" and choose "Import to Bibtex" under the target item.
- Copy the citation information of this article into the file "Myrefs.bib"
- Research dominant: cite this article by `\citep{lampport1986document}` like here [4]
- Citation dominant: cite this article by `\citet{lampport1986document}` like here Lampport [4]
- References list is generated automatically.

1.3.5 Generate nomenclature

In this template, a simple command for adding nomenclatures is provided. Therefore, packages for automatical nomenclature generation are not included. From my point of view, there is no need to use those packages and make things complicated. However, if you insist, there are a lot of available packages for creating nomenclatures. Recommended options are (Please Google the one you want to know):

- listofsymbols
- nomencl

1.4 File Tree of Current Template

- Thesis.tex: main tex file, which acts like the main function in C++.
- Style: Store template configuration files, which act like subfunctions.
- Tmp: Store files generated by compilation.
- Biblio: Store information of references.
- Img: Store images.
- Tex: Store files for your content, this is the working directory.

- Frontpages: content of front pages, like authorship, abstract, etc.
- Prematter: content of nomenclature, etc.
- Main_Content: index for chapters you want to include into your current content.
- Chap_***: your content for each chapters.
- Appendix: appendix.
- Useful Commands: collection of useful commands.

Note: this template can be easily adapted to other writing purposes such as articles. What you need to do is to change and adjust a few items in the "Thesis.tex" file, which would be very easy after you are a little familiar with using L^AT_EX. Like :

Change `\documentclass{uwaterloothesis}` to `\documentclass{article}`

1.5 Feedback and Problems

Please feel free to send me emails for any related problems:

huangrui.mo@uwaterloo.ca

Appendix A

Other Information

References

- [1] Wikipedia, Latex, <http://en.wikipedia.org/wiki/LaTeX> (2014).
- [2] LaTeX, Latex – a document preparation system, <http://www.latex-project.org/> (2014).
- [3] Wikibook, Latex, <http://en.wikibooks.org/wiki/LaTeX> (2014).
- [4] L. Lamport, Document Preparation System, Addison-Wesley Reading, MA, 1986.