



SAMPLE THESIS CREATED BY USING L_YX WITH ARABIC SUPPORT

By
Ahmed Mohamed Rashed Desoki

A Thesis Submitted to the
Faculty of Engineering at Cairo University
in Partial Fulfillment of the
Requirements for the Degree of

MASTER OF SCIENCE
in
Aerospace Engineering

FACULTY OF ENGINEERING, CAIRO UNIVERSITY
GIZA, EGYPT
July, 2017

Proudly created by

Except for the figures created by Matlab¹, this thesis has been created by *open source software* (OSS) packages. Special thanks go to the numerous generous developers behind the following projects:

GNU project free software, mass collaboration project aiming to give users freedom

L^AT_EX document markup language

T_EX Live cross-platform L^AT_EX distribution

MiK_TE_X L^AT_EX distribution for Windows

L_YX cross-platform L^AT_EX-based document preparation system

Beamer L^AT_EX class for creating presentation slides and handouts

Ara^{bi} Arabic typesetting package for L^AT_EX

Inkscape cross-platform vector graphics editor

T_EX Text Inkscape plugin for creating and editing L^AT_EX formulae

Other great projects I failed to mention ...

Other software packages

Other software packages that greatly helped me during this research include:

Areca cross-platform incremental backup package

pdfcrop a Perl program for removing white margins of a pdf file; indispensable for exported Matlab figures

GoldenDict cross-platform feature-rich dictionary lookup program

¹For your information, NumPy + SciPi + Matplotlib + Spyder offer very competitive alternative to Matlab. For Windows, all these packages and more are distributed by *Python(x,y)*.

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Key Words:

Keyword1; Keyword2; Keyword3; Keyword4; Keyword5; Keyword6; Keyword7;
Keyword8; Keyword9; Keyword9; Keyword10.

Summary:

I'm Ahmed Mohamed Rashed Desoki, an assistant professor at Aerospace Engineering Department, Cairo University.

I created this thesis template to help you how you can create a professional thesis using OSS. I tried to cite all the sources that helped me create this sample.

If you face a problem, please try hard to read, learn and dig for a solution by yourself. In case you have suggestions, corrections, bugs or improvement, please contribute to the Git page of this template.

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Abstract

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Acknowledgments

Thanks to the Allah who helped me completing this template. I ask him to accept it from me for the sake of his mercy.

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Table of Contents

Abstract	i
Acknowledgments	iii
Table of Contents	v
List of Tables	vii
List of Figures	ix
List of Codes	xi
Nomenclature	xiii
1 Word Processors; L^AT_EX vs MS Word	1
2 L^AT_EX; a Document Markup Language	3
2.1 L ^A T _E X Editors	3
2.2 Porting a L ^A T _E X Document	6
2.3 Arabic Support	6
2.4 Installing L ^A T _E X	6
3 L^AX; a Graphical Front-End to L^AT_EX	7
3.1 Installing L ^A X	7
3.2 Learning L ^A X	8
3.3 Porting a L ^A X Document	8
3.4 Arabic Support	10
4 Floats, Figures, Tables and Equations	11
4.1 Concept of Floating Graphics, Tables	11
4.2 Compound Figures	11
4.2.1 Subfigure and Subtable	11
4.3 Continued Floats	11
4.4 Landscape Floats	11
4.5 Side-by-Side Facing Floats	11
4.6 Tables	12
4.7 Equations	12
4.7.1 SDOF Mass Spring System	12
4.7.2 Inverse Laplace Transform Derivation	15

5	Reference Management Software	19
6	Vector Graphics	21
6.1	Raster vs Vector Graphics	21
6.2	Vector Graphics Editors	21
7	Inkscape; Free and Open Source Vector Graphics Editor	25
7.0.1	Import Graphics from pdf	25
7.1	Interesting Plug-ins	26
7.1.1	Function Plotter	26
7.1.2	TexText	26
7.1.2.1	Installing TexText on MS Windows (all versions, including 32 & 64 bit)	26
7.1.2.2	Installing TexText on Linux	27
7.2	Learning Inkscape	27
8	Including Program Codes	29
9	Nomenclature	31
9.1	Problems with Arabic	31
A	Matlab Codes	33
	References	39
	Index	41
	الخلاصة	42

List of Tables

1.1	L^AT_EX vs Microsoft Word	2
4.1	Table caption	13
4.2	Comparison between somethings	14

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List of Figures

1.1	Effort and time consumption of MS Word as compared to \LaTeX .	2
2.1	\LaTeX cheat sheet	4
3.1	Correcting svg converters in Inkscape	9
4.1	Figure composed of a subfigure and subtable	12
4.2	SDOF Mass Spring System	13
6.1	Sample raster graphics. This figure is forced to be on a left page for easier comparison with figure 6.2 on the opposite page.	22
6.2	Vector graphics version of figure 6.1	23
7.1	Vector graphic imported from the user guide of a home use ADSL router	26
7.2	The Function Plotter plugin	27
7.3	Figure illustrating the capabilities of “Function Plotter” and “TextText” plug ins.	28

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List of Codes

A.1	SDOF_Free_Response_Visc_main	33
A.2	function SDOF_Free_Response_Visc.m	34
A.3	function export_figure	34

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Nomenclature

IDE Integrated Development Environment, page 6

IRF Impulse Response Function, page 15

MS Microsoft, page 1

ode ordinary differential equation, page 13

OSS Open Source Software, page i

SDOF Single Degree Of Freedom, page 12

TF Transfer Function, page 14

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Chapter 1

Word Processors; \LaTeX vs MS Word

Usually there are two categories of word processing software packages; table 1.1

- What You See Is What You Get (WYSIWYG)
- What You See Is What You Mean (WYSIWYM)

Roughly, you can compare \LaTeX to Word as you compare Matlab to Excel. Figure 1.1 visualizes the effort and time consumption needed.

By the way, if you are annoyed by the existence of table 1.1 and figure 1.1 at the following page, this is explained in <http://tex.stackexchange.com/questions/66293/strange-behaviour-with-figure-on-chapter-first-page>

WYSIWYG	WYSIWYM
Microsoft Word LibreOffice Writer AbiWord Calligra Words	\LaTeX LyX

Table 1.1: \LaTeX vs Microsoft Word

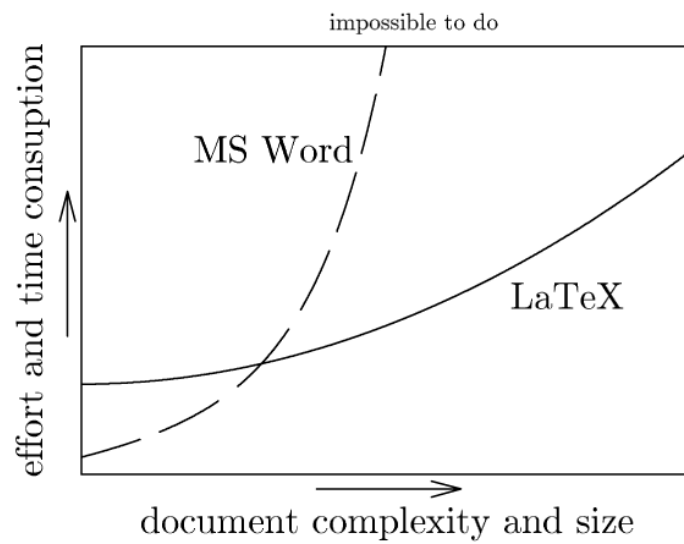


Figure 1.1: Effort and time consumption of MS Word as compared to \LaTeX .

Chapter 2

L^AT_EX; a Document Markup Language

L^AT_EX is a document markup language.

- Simply you can think of it as similar to HTML¹
- In order to create a document in L^AT_EX, a **.tex** file must be created using some text editor
- The **.tex** file is then compiled to produce the document
- L^AT_EX can generate several document formats including “pdf”

L^AT_EX is Free

Although being free is an advantage, but it is a drawback at the same time! Free implies:

- Slow download server
- No clean official documentation
- Several alternatives to do the same thing

However; L^AT_EX is very mature and widely used by professional/enterprise publishers

- Also it has a big user community
 - when you encounter a problem, google it. Most likely you will find others had encountered it and found a solution

2.1 L^AT_EX Editors

- To write C/C++ code, any text editor can be used
 - But using a good IDE can greatly ease your job
- L^AT_EX is similar
 - Any text editor is OK, but a dedicated L^AT_EX editor is strongly recommended
- A dedicated L^AT_EX editor

¹(HyperText Markup Language)

\LaTeX 2_ε Cheat Sheet

Document classes

`book` Default is two-sided.
`report` No `\part` divisions.
`article` No `\part` or `\chapter` divisions.
`letter` Letter (?).
`slides` Large sans-serif font.
Used at the very beginning of a document:
`\documentclass{class}`. Use `\begin{document}` to start
contents and `\end{document}` to end the document.

Common documentclass options

`10pt/11pt/12pt` Font size.
`letterpaper/a4paper` Paper size.
`twocolumn` Use two columns.
`twoside` Set margins for two-sided.
`landscape` Landscape orientation. Must use `dvips`
`-t landscape`.
`draft` Double-space lines.
Usage: `\documentclass[opt,opt]{class}`.

Packages

`fullpage` Use 1 inch margins.
`anysize` Set margins: `\marginsize{l}{r}{t}{b}`.
`multicol` Use n columns: `\begin{multicols}{n}`.
`latexsym` Use \LaTeX symbol font.
`graphicx` Show image: `\includegraphics[width=x]{file}`.
`url` Insert URL: `\url{http://...}`.
Use before `\begin{document}`. Usage: `\usepackage{package}`

Title

`\author{text}` Author of document.
`\title{text}` Title of document.
`\date{text}` Date.
These commands go before `\begin{document}`. The
declaration `\maketitle` goes at the top of the document.

Miscellaneous

`\pagestyle{empty}` Empty header, footer and no page num-
bers.
`\tableofcontents` Add a table of contents here.

Document structure

`\part{title}` `\subsubsection{title}`
`\chapter{title}` `\paragraph{title}`
`\section{title}` `\subparagraph{title}`
`\subsection{title}`
Use `\setcounter{secnumdepth}{x}` suppresses heading
numbers of depth $> x$, where `chapter` has depth 0. Use a `*`, as
in `\section*{title}`, to not number a particular item—these
items will also not appear in the table of contents.

Text environments

`\begin{comment}` Comment (not printed). Requires `verbatim`
package.
`\begin{quote}` Indented quotation block.
`\begin{quotation}` Like `quote` with indented paragraphs.
`\begin{verse}` Quotation block for verse.

Lists

`\begin{enumerate}` Numbered list.
`\begin{itemize}` Bulleted list.
`\begin{description}` Description list.
`\item text` Add an item.
`\item[x] text` Use x instead of normal bullet or number.
Required for descriptions.

References

`\label{marker}` Set a marker for cross-reference, often of the
form `\label{sec:item}`.
`\ref{marker}` Give section/body number of marker.
`\pageref{marker}` Give page number of marker.
`\footnote{text}` Print footnote at bottom of page.

Floating bodies

`\begin{table}[place]` Add numbered table.
`\begin{figure}[place]` Add numbered figure.
`\begin{equation}[place]` Add numbered equation.
`\caption{text}` Caption for the body.
The *place* is a list valid placements for the body. `t=top`,
`b=bottom`, `p=separate page`, `!place` even if ugly.
Captions and label markers should be within the environment.

Text properties

Font face

Command	Declaration	Effect
<code>\textrm{text}</code>	<code>\rmfamily text</code>	Roman family
<code>\textsf{text}</code>	<code>\sffamily text</code>	Sans serif family
<code>\texttt{text}</code>	<code>\ttfamily text</code>	Typewriter family
<code>\textmd{text}</code>	<code>\mdseries text</code>	Medium series
<code>\textbf{text}</code>	<code>\bfseries text</code>	Bold series
<code>\textup{text}</code>	<code>\upshape text</code>	Upright shape
<code>\textit{text}</code>	<code>\itshape text</code>	<i>Italic shape</i>
<code>\textsl{text}</code>	<code>\slshape text</code>	<i>Slanted shape</i>
<code>\textsc{text}</code>	<code>\scshape text</code>	SMALL CAPS SHAPE
<code>\emph{text}</code>	<code>\em text</code>	<i>Emphasized</i>
<code>\textnormal{text}</code>	<code>\normalfont text</code>	Document font
<code>\underline{text}</code>		<u>Underline</u>

The command (`tttt`) form handles spacing better than the
declaration (`tttt`) form.

Font size

<code>\tiny</code>	<small>tiny</small>	<code>\Large</code>	Large
<code>\scriptsize</code>	<small>scriptsize</small>	<code>\LARGE</code>	LARGE
<code>\footnotesize</code>	<small>footnotesize</small>		
<code>\small</code>	<small>small</small>	<code>\huge</code>	huge
<code>\normalsize</code>	<small>normalsize</small>		
<code>\large</code>	<small>large</small>	<code>\Huge</code>	Huge

These are declarations and should be used in the form `\small`
`...`, or without braces to affect the entire document.

Verbatim text

`\begin{verbatim}` Verbatim environment.
`\begin{verbatim*}` Spaces are shown as `␣`.
`\verb!text!` Text between the delimiting characters (in
this case `!'`) is verbatim.

Justification

Environment	Declaration
<code>\begin{center}</code>	<code>\centering</code>
<code>\begin{flushleft}</code>	<code>\raggedright</code>
<code>\begin{flushright}</code>	<code>\raggedleft</code>

Miscellaneous

`\linespread{x}` changes the line spacing by the multiplier x .

Text-mode symbols

Symbols

<code>&</code>	<code>\&</code>	<code>~</code>	<code>_</code>	<code>...</code>	<code>\ldots</code>	<code>•</code>	<code>\textbullet</code>
<code>\$</code>	<code>\\$</code>	<code>^</code>	<code>\^{}{}</code>	<code> </code>	<code>\textbar</code>	<code>\</code>	<code>\textbackslash</code>
<code>%</code>	<code>\%</code>	<code>~</code>	<code>\~{}{}</code>	<code>#</code>	<code>\#</code>	<code>§</code>	<code>\S</code>

Accents

<code>ò \’o</code>	<code>ó \’o</code>	<code>ô \’o</code>	<code>õ \’o</code>	<code>ö \’o</code>
<code>ô \’o</code>	<code>ö \’o</code>	<code>q \’c o</code>	<code>ô \’v o</code>	<code>ö \’H o</code>
<code>ç \’c c</code>	<code>q \’d o</code>	<code>q \’b o</code>	<code>öo \’t oo</code>	<code>æ \’oe</code>
<code>Ë \’OE</code>	<code>æ \’ae</code>	<code>Æ \’AE</code>	<code>ä \’aa</code>	<code>Å \’AA</code>
<code>ø \’o</code>	<code>Ø \’O</code>	<code>ı \’ı</code>	<code>L \’L</code>	<code>ı \’ı</code>
<code>j \’j</code>	<code>i \’i</code>	<code>ı \’ı</code>		

Delimiters

<code>‘ ‘ ‘ ‘</code>	<code>{ { { {</code>	<code>[[[[</code>	<code>((((</code>	<code><</code>	<code>\textless</code>
<code>, , , ,</code>	<code>} } } }</code>	<code>]]]]</code>	<code>))))</code>	<code>></code>	<code>\textgreater</code>

Dashes

Name	Source	Example	Usage
hyphen	–	X-ray	In words.
en-dash	--	1–5	Between numbers.
em-dash	---	Yes—or no?	Punctuation.

Line and page breaks

`\` Begin new line without new paragraph.
`\`* Prohibit pagebreak after linebreak.
`\kill` Don’t print current line.
`\pagebreak` Start new page.
`\noindent` Do not indent current line.

Miscellaneous

`\today` February 25, 2014.
`\sim` Prints `~` instead of `\^{}{}`, which makes `~`.
`~` Space, disallow linebreak (W.J.~Clinton).
`\@.` Indicate that the `.` ends a sentence when following
an uppercase letter.
`\hspace{l}` Horizontal space of length l (Ex: $l = 20\text{pt}$).
`\vspace{l}` Vertical space of length l .
`\rule{w}{h}` Line of width w and height h .

Tabular environments

tabbing environment

`\=` Set tab stop. `\>` Go to tab stop.
Tab stops can be set on “invisible” lines with `\kill` at the end
of the line. Normally `\` is used to separate lines.

Figure 2.1: \LaTeX cheat sheet (*continued in the next page*)

tabular environment

```
\begin{array}[pos]{cols}
\begin{tabular}[pos]{cols}
\begin{tabular*}[pos]{cols}
```

tabular column specification

```
l      Left-justified column.
c      Centered column.
r      Right-justified column.
p{width} Same as \parbox[t]{width}.
@{decl} Insert decl instead of inter-column space.
|      Inserts a vertical line between columns.
```

tabular elements

```
\hline      Horizontal line between rows.
\cline{x-y} Horizontal line across columns x through y.
\multicolumn{n}{cols}{text}
           A cell that spans n columns, with cols column
           specification.
```

Math mode

For inline math, use $\backslash(\dots)$ or $\$...\$$. For displayed math, use $\backslash[...]$ or $\backslashbegin{equation}$.

```
Superscriptx  ^{x}      Subscriptx  _{x}
 $\frac{x}{y}$     \frac{x}{y}   $\sum_{k=1}^n$   \sum_{k=1}^n
 $\sqrt{x}$        \sqrt[n]{x}   $\prod_{k=1}^n$     \prod_{k=1}^n
```

Math-mode symbols

```
<= \leq      >= \geq      ≠ \neq      ≈ \approx
× \times     ÷ \div      ± \pm        · \cdot
° ~{\circ}   ° \circ     ′ \prime    … \cdots
∞ \infty     ¬ \neg      ∧ \wedge   ∨ \vee
⊃ \supset    ∀ \forall     ∈ \in      → \rightarrow
⊂ \subset    ∃ \exists     ∉ \notin   ⇒ \Rightarrow
∪ \cup       ∩ \cap     | \mid     ⇔ \Leftrightarrow
â \dot a     â \hat a    ā \bar a    ã \tilde a
α \alpha     β \beta     γ \gamma    δ \delta
ε \epsilon   ζ \zeta     η \eta      ε \varepsilon
θ \theta     ι \iota     κ \kappa    ϑ \vartheta
λ \lambda     μ \mu      ν \nu      ξ \xi
π \pi        ρ \rho     σ \sigma    τ \tau
υ \upsilon    φ \phi     χ \chi      ψ \psi
ω \omega     Γ \Gamma    Δ \Delta    Θ \Theta
Λ \Lambda     Ξ \Xi     Π \Pi      Σ \Sigma
Υ \Upsilon   Φ \Phi     Ψ \Psi     Ω \Omega
```

Bibliography and citations

When using BibTeX, you need to run latex, bibtex, and latex twice more to resolve dependencies.

Citation types

```
\cite{key}      Full author list and year. (Watson and Crick
1953)
\citeA{key}     Full author list. (Watson and Crick)
\citeN{key}     Full author list and year. Watson and Crick
(1953)
\shortcite{key} Abbreviated author list and year. ?
\shortciteA{key} Abbreviated author list. ?
\shortciteN{key} Abbreviated author list and year. ?
\citeyear{key}  Cite year only. (1953)
All the above have an NP variant without parentheses; Ex.
\citeNP.
```

BibTeX entry types

```
@article      Journal or magazine article.
@book         Book with publisher.
@booklet      Book without publisher.
@conference   Article in conference proceedings.
@inbook       A part of a book and/or range of pages.
@incollection A part of book with its own title.
@misc         If nothing else fits.
@phdthesis    PhD. thesis.
@proceedings  Proceedings of a conference.
@techreport   Tech report, usually numbered in series.
@unpublished  Unpublished.
```

BibTeX fields

```
address       Address of publisher. Not necessary for major
publishers.
author        Names of authors, of format ....
booktitle     Title of book when part of it is cited.
chapter       Chapter or section number.
edition       Edition of a book.
editor        Names of editors.
institution    Sponsoring institution of tech. report.
journal       Journal name.
key           Used for cross ref. when no author.
month         Month published. Use 3-letter abbreviation.
note          Any additional information.
number        Number of journal or magazine.
organization  Organization that sponsors a conference.
pages         Page range (2,6,9--12).
publisher     Publisher's name.
school        Name of school (for thesis).
series        Name of series of books.
title         Title of work.
type          Type of tech. report, ex. "Research Note".
volume        Volume of a journal or book.
year          Year of publication.
```

Not all fields need to be filled. See example below.

Common BibTeX style files

```
abbrv  Standard      abstract  alpha with abstract
alpha  Standard      apa      APA
plain  Standard      unsrt    Unsorted
```

The L^AT_EX document should have the following two lines just before $\backslash\end{document}$, where bibfile.bib is the name of the BibTeX file.

```
\bibliographystyle{plain}
\bibliography{bibfile}
```

BibTeX example

The BibTeX database goes in a file called file.bib, which is processed with bibtex file.

```
@String{N = {Na\~{t}ure}}
@Article{WC:1953,
  author = {James Watson and Francis Crick},
  title = {A structure for Deoxyribose Nucleic Acid},
  journal = N,
  volume = {171},
  pages = {737},
  year = 1953
}
```

Sample L^AT_EX document

```
\documentclass[11pt]{article}
\usepackage{fullpage}
\title{Template}
\author{Name}
\begin{document}
\maketitle

\section{section}
\subsection*{subsection without number}
text \textbf{bold text} text. Some math:  $2+2=5$ 
\subsection{subsection}
text \emph{emphasized text} text. \cite{WC:1953}
discovered the structure of DNA.
```

```
A table:
\begin{table}[!th]
\begin{tabular}{|l|c|r|}
\hline
first & row & data \\
second & row & data \\
\hline
\end{tabular}
\caption{This is the caption}
\label{ex:table}
\end{table}
```

The table is numbered $\backslash\ref{ex:table}$.
 $\backslash\end{document}$

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<http://www.stdot.org/~winston/latex/>

Figure 2.1: (continued) L^AT_EX cheat sheet

- can highlight and auto complete L^AT_EX keywords
- has several L^AT_EX templates for several types of documents
- facilitates compiling and debugging
- ...
- Sample L^AT_EX editors are:
 - Texstudio**; cross-platform
 - Kile**; for Linux
 - and** many others

2.2 Porting a L^AT_EX Document

Usually L^AT_EX source files reference images and other external files. Hence, if you want to move/copy your L^AT_EX document to another computer, you have to move/copy all the referenced files as well.

2.3 Arabic Support

Thanks to² the Arabipackage, Arabic and Farsi languages are supported with the “Babel” package.

However, since arabic users are few, “Arabi” package is not mature enough and some minor bugs do exist. Googling about these bugs, usually you find the same of similar bugs do exist in other languages, and hence you can infer solutions/workarounds.

2.4 Installing L^AT_EX

To install and use L^AT_EX, basically you need two things; (1) L^AT_EX implementation and (2) Integrated Development Environment (IDE).

For MS Windows users, proText³ is a T_EX/L^AT_EX distribution that includes:

- MiK_T_EX: L^AT_EX Implementation for MS Windows
- TexStudio: cross-platform T_EX/L^AT_EX IDE

For Linux and MAC OS, T_EX Live is a cross platform L^AT_EX implementation⁴, and there is a wide range of IDE’s including TexStudio.

Keep Concentrating

Due to its WYSIWYM nature, I feel more concentrating while using L^AT_EX as compared to **Ms-Word**

²Thanks to GOD at first of course.

³<https://www.tug.org/protext/>

⁴That is, it is a cross-platform alternative to MiK_T_EX.

Chapter 3

LyX; a Graphical Front-End to L^AT_EX

LyX is a graphical front-end to L^AT_EX

- You can think of the LyX-L^AT_EX relationship as similar to the Visual Studio-C++ compiler relationship
- Unlike L^AT_EX, LyX comes with tidy and very good documentation
- Also it has a big community, i.e.,
 - it is mature enough
 - when you encounter a problem, google it. Most likely you will find others had encountered it and found a solution

Keep your concentration

Due to its WYSIWYM nature, I feel very concentrating while using **LyX** as compared to **Ms-Word**.

3.1 Installing LyX

Windows installer is available at www.lyx.org/

There are two installer variants:

1. Installer (recommended)
This needs a pre-installed L^AT_EX distribution
2. Bundle
It includes a minimal L^AT_EX distribution

I recommend installing as follows:

1. Install Inkscape
 - Confirm path to inkscape.exe is added to the “PATH” environment variable
2. Install MiK_TE_X (or T_EX Live)

3. Install L^AT_EX (Installer option)
4. Modify L^AT_EX configurations to use Inkscape as graphics translator, as explained in figure 3.1. That is, Tools▷Preferences▷Converters

SVG -> EPS: inkscape --export-area-drawing \$\$i
 --export-eps=\$\$o

SVG -> PDF (graphics): inkscape --export-area-drawing \$\$i
 --export-pdf=\$\$o

SVG -> PNG: inkscape --export-area-drawing \$\$i
 --export-png=\$\$o
5. Enable continuous spell checking

Tools▷Preferences▷Language Settings▷Spellchecker▷Spellcheck continuously

Linux packages are usually available in most Linux distributions' repositories

3.2 Learning L^AT_EX

Explore style-list, menus and toolbars

Help menu includes very good manuals

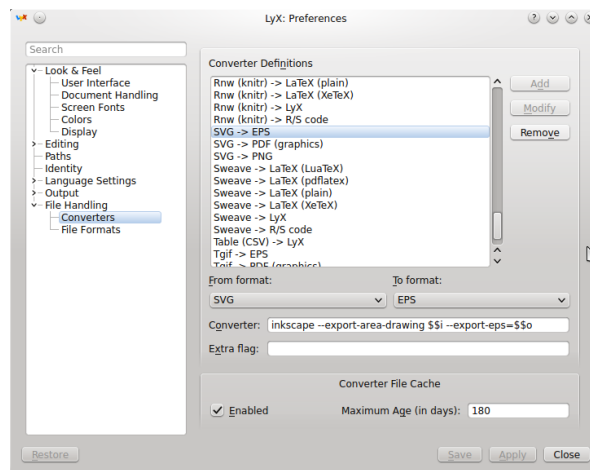
- Manuals themselves are L^AT_EX documents
 - So they are essentially very good L^AT_EX examples
- You may begin with:
 1. Introduction
 2. Tutorial
- Then if needed, read necessary sections of:
 1. User's Guide
 2. rest of manuals ...

lyx\examples folder contains wide variety of very good examples

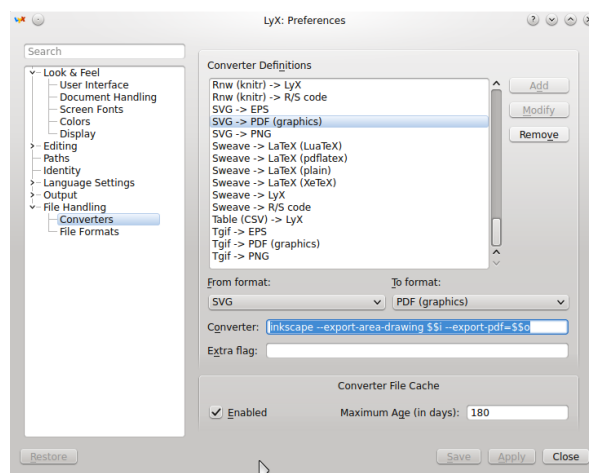
3.3 Porting a L^AT_EX Document

Similar to L^AT_EX files, L^AT_EX files usually reference images and other external files. Hence, if you want to move/copy your L^AT_EX document to another computer, you have to move/copy all the referenced files as well.

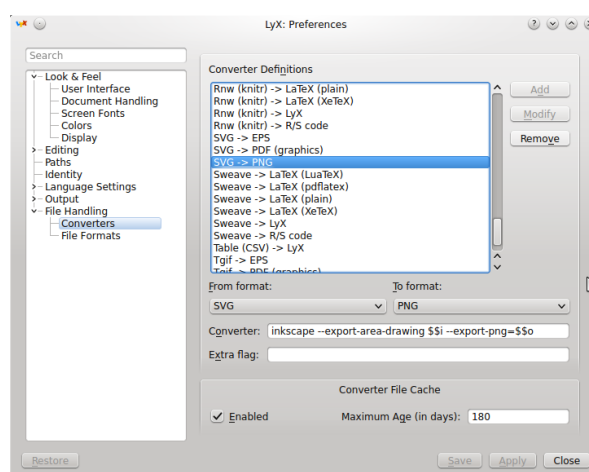
L^AT_EX greatly simplifies collecting the referenced files by the command L^AT_EX▷File▷Export▷L^AT_EX Archive



(a) To convert svg to eps



(b) To convert svg to pdf



(c) To convert svg to png

Figure 3.1: Correcting svg converters in Inkscape

3.4 Arabic Support

Arabic is supported in L^AT_EX, as shown in the following. For more details, refer to section 2.3.

This is an English paragraph with Arabic sentences. This is an English paragraph with Arabic sentences. This is an English paragraph with Arabic sentences. هذه جملة عربية فى فقرة انجليزية. هذه جملة عربية فى فقرة انجليزية. هذه جملة عربية فى فقرة انجليزية. هذه جملة عربية فى فقرة انجليزية. This is an English paragraph with Arabic sentences. This is an English paragraph with Arabic sentences.

هذه جملة انجليزية فى فقرة عربية. هذه جملة انجليزية فى فقرة عربية. Thus is some English words in an Arabic line. Thus is some English words in an Arabic line. Thus is some English words in an Arabic line. هذه جملة انجليزية فى فقرة عربية. هذه جملة انجليزية فى فقرة عربية. انجليزية فى فقرة عربية.

و هذه فقرة عربية. و هذه فقرة عربية. و هذه فقرة عربية. و هذه فقرة عربية. و هذه فقرة عربية. و هذه فقرة عربية. و هذه فقرة عربية. و هذه فقرة عربية. و هذه فقرة عربية. و هذه فقرة عربية. و هذه فقرة عربية.

Chapter 4

Floats, Figures, Tables and Equations

4.1 Concept of Floating Graphics, Tables

For those users familiar with MS Word, they expect figures and tables are placed where you put them. This however does not look professional. Therefore, \LaTeX , and consequently \LyX , uses floats for placing figures and tables. Sample simple floating figures are figures [1.1](#), [7.1](#)

For more information about this topic, refer to [\[1\]](#) and [\[2, sec. 4.6\]](#).

4.2 Compound Figures

Figures composed of sub-figures can be created in by using the subcaption \LaTeX package. Sample compound figures are figures [2.1](#), [3.1](#), [4.1](#), [6.1](#), [6.2](#), [7.2](#) and [7.3](#).

4.2.1 Subfigure and Subtable

Have a look to figure [4.1](#).

4.3 Continued Floats

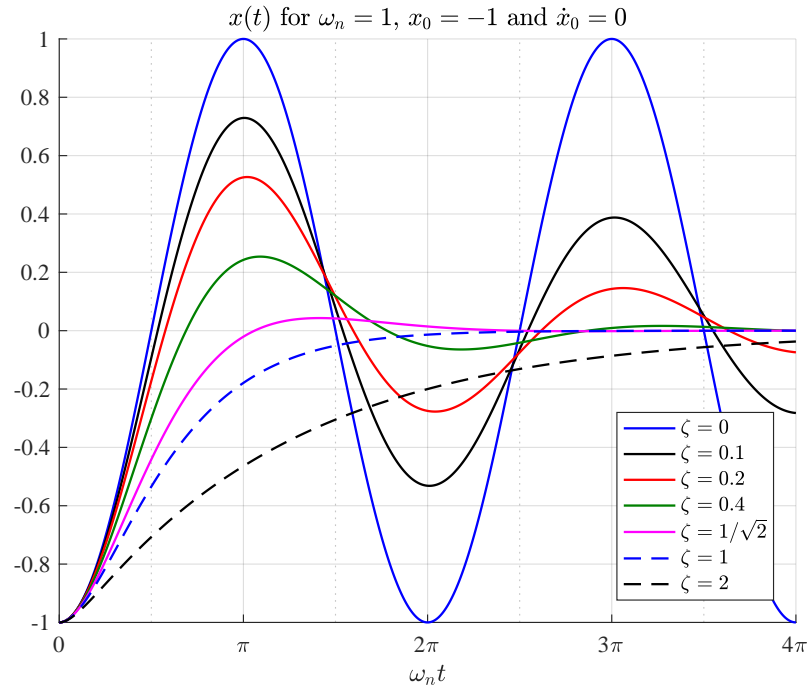
Figure [2.1](#) shows a sample float continued from a float to another.

4.4 Landscape Floats

Have a look to figure [2.1](#).

4.5 Side-by-Side Facing Floats

Have a look to figures [6.1](#) and [6.2](#).



(a) Free vibration of a SDOF system

ρ_{ij}	$i = 1$	$i = 2$	$i = 3$	$i = 4$
$j = 1$	1.0000	-0.0000	-0.8328	-0.0010
$j = 2$	-0.0000	1.0000	-0.0000	-0.8328
$j = 3$	-0.8328	-0.0000	1.0000	-0.0000
$j = 4$	-0.0010	-0.8328	-0.0000	1.0000

(b) Correlation coefficient matrix

Figure 4.1: Figure composed of a subfigure and subtable

4.6 Tables

Table 4.1 shows a sample simple table, while table 4.2 shows a more complex table. Additional details are available in [2, sec. 4.5] and [1, chapter 2].

4.7 Equations

For details about equations, refer to [3]. The following is sample text with various types of equations.

4.7.1 SDOF Mass Spring System

Table 4.1: Table caption

	Conventional Transducer	This Transducer
Price	word word	word word
Size	word word	word word
Weight	word word	word word
Coupling	word word	word word
Material	word word	word word
Generation	word word	word word
Suitability	word word	word word
Restrictions	word word	word word
Action type	word word	word word

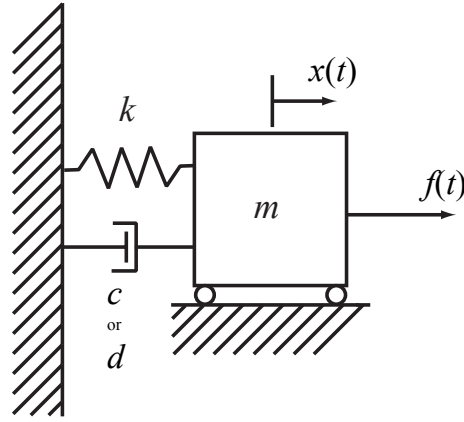


Figure 4.2: SDOF Mass Spring System

Governing Ordinary Differential Equation (ode)

$$m\ddot{x}(t) + c\dot{x}(t) + kx(t) = f(t) \quad (4.1)$$

Taking Laplace transform, the *ode* is transformed to the algebraic equation

$$m(s^2X(s) - sx_0 - \dot{x}_0) + c(sX(s) - x_0) + kX(s) = F(s)$$

where $x_0 \equiv x(t=0)$ and $\dot{x}_0 \equiv \dot{x}(t=0)$.

Rearranging yields

$$(ms^2 + cs + k)X(s) - (ms + c)x_0 - m\dot{x}_0 = F(s) \quad (4.2)$$

Dividing by m yields

$$(s^2 + 2\zeta\omega_n s + \omega_n^2)X(s) - (s + 2\zeta\omega_n)x_0 - \dot{x}_0 = \frac{F(s)}{m} \quad (4.3)$$

where the non-dimensional parameters ω_n and ζ are the **natural frequency** and **damping ratio** defined as

$$\boxed{\omega_n \equiv \sqrt{\frac{k}{m}}} \quad \& \quad \boxed{\zeta \equiv \frac{c}{c_c}} \quad (4.4)$$

Table 4.2: Comparison between somethings

	Type 1	Type 2	Type 3	Type 4
Feature 1	words words words words words words words	words words words words words words words	words words words words words words words	words words words words words words words
Feature 2	words words words words words words words	words words words words words words words	words words words words words words words	words words words words words words words
Feature 3	words words words words words words words	words words words words words words words	words words words words words words words	words words words words words words words
Feature 4	words words words words words words words	words words words words words words words	words words words words words words words	words words words words words words words

where c_c is the *critical damping* defined as

$$c_c \equiv 2\sqrt{km} \quad (4.5)$$

By solving the algebraic equation (4.3), the response $X(s)$ is obtained as

$$X(s) = \frac{F(s)}{m(s^2 + 2\zeta\omega_n s + \omega_n^2)} + \frac{s x_0}{s^2 + 2\zeta\omega_n s + \omega_n^2} + \frac{2\zeta\omega_n x_0 + \dot{x}_0}{s^2 + 2\zeta\omega_n s + \omega_n^2}$$

or

$$X(s) = F(s) H(s) + \frac{s x_0}{s^2 + 2\zeta\omega_n s + \omega_n^2} + \frac{2\zeta\omega_n x_0 + \dot{x}_0}{s^2 + 2\zeta\omega_n s + \omega_n^2} \quad (4.6)$$

where $H(s)$ is the *Transfer Function* (TF) defined as

$$H(s) \equiv \frac{X(s)|_{\text{zero initial conditions}}}{F(s)} \quad (4.7)$$

$$= \frac{1}{ms^2 + cs + k} \quad (4.8)$$

$$= \frac{1}{m(s^2 + 2\zeta\omega_n s + \omega_n^2)} \quad (4.9)$$

$$= \frac{1}{m \left(s - \left(-\zeta\omega_n + \omega_n \sqrt{\zeta^2 - 1} \right) \right) \left(s - \left(-\zeta\omega_n - \omega_n \sqrt{\zeta^2 - 1} \right) \right)} \quad (4.10)$$

Assuming the roots of $H(s)$ are complex, the TF is written as

$$H(s) = \frac{1}{m \left(s - \left(-\zeta\omega_n + i\omega_n \sqrt{1 - \zeta^2} \right) \right) \left(s - \left(-\zeta\omega_n - i\omega_n \sqrt{1 - \zeta^2} \right) \right)} \quad (4.11)$$

or

$$H(s) = \frac{1}{m(s - (-\zeta\omega_n + i\omega_d))(s - (-\zeta\omega_n - i\omega_d))} \quad (4.12)$$

where

$$\omega_d \equiv \omega_n \sqrt{1 - \zeta^2} \quad (4.13)$$

Thus the response $x(t)$ can be obtained from equation (4.6) as

$$x(t) = \mathcal{L}^{-1} [X(s)] \quad (4.14)$$

where \mathcal{L}^{-1} denotes inverse Laplace transform.

Assuming the TF roots are complex, i.e., $\zeta < 1$, inverse Laplace transform tables yield

$$\begin{aligned} x(t) = & \mathcal{L}^{-1} [F(s) H(s)] \\ & + x_0 e^{-\zeta\omega_n t} \left(\cos(\omega_d t) - \frac{\zeta\omega_n}{\omega_d} \sin(\omega_d t) \right) \\ & + (2\zeta\omega_n x_0 + \dot{x}_0) e^{-\zeta\omega_n t} \frac{\sin(\omega_d t)}{\omega_d} \end{aligned} \quad (4.15)$$

Rearranging yields

$$\begin{aligned} x(t) = & \mathcal{L}^{-1} [F(s) H(s)] \\ & + e^{-\zeta\omega_n t} \left[x_0 \cos(\omega_d t) + (\zeta\omega_n x_0 + \dot{x}_0) \frac{\sin(\omega_d t)}{\omega_d} \right] \end{aligned} \quad (4.16)$$

or from the convolution property

$$\begin{aligned} x(t) = & (f * h)(t) \\ & + e^{-\zeta\omega_n t} \left[x_0 \cos(\omega_d t) + (\zeta\omega_n x_0 + \dot{x}_0) \frac{\sin(\omega_d t)}{\omega_d} \right] \end{aligned} \quad (4.17)$$

where

$$h(t) \equiv \mathcal{L}^{-1} [H(s)] = \frac{e^{-\zeta\omega_n t} \sin(\omega_d t)}{m \omega_d} \quad (4.18)$$

is the Impulse Response Function (IRF), and

$$(f * h)(t) \equiv \int_{-\infty}^{\infty} f(\tau) h(t - \tau) d\tau \quad (4.19)$$

$$= \int_0^t f(\tau) h(t - \tau) d\tau \quad , : f(t) = h(t) = 0 \quad \forall t < 0 \quad (4.20)$$

is the convolution of $f(t)$ and $h(t)$, assuming stable, linear, physically possible and time invariant system.

4.7.2 Inverse Laplace Transform Derivation

Using Laplace transform property, inverse Laplace can be obtained as

$$\frac{\Omega s}{(s^2 + \Omega^2)(s^2 + 2\zeta\omega_n s + \omega_n^2)} \xleftrightarrow{\mathcal{L}} \dot{y}(t) + y(0) \quad (4.21)$$

where $y(t)$ is the inverse Laplace transform of

$$\frac{\Omega}{(s^2 + \Omega^2)(s^2 + 2\zeta\omega_n s + \omega_n^2)}$$

previously derived as

$$y(t) = \frac{-2\zeta r \cos(\Omega t) + (1 - r^2) \sin(\Omega t) + r e^{-\zeta\omega_n t} \left[2\zeta \cos(\omega_d t) + \omega_n (2\zeta^2 - (1 - r^2)) \frac{\sin(\omega_d t)}{\omega_d} \right]}{\omega_n^2 ((1 - r^2)^2 + (2\zeta r)^2)} \quad (4.22)$$

Thus

$$y(0) = \frac{-2\zeta r + 2\zeta r}{\omega_n^2 ((1 - r^2)^2 + (2\zeta r)^2)} = 0 \quad (4.23)$$

and

$$\begin{aligned} \dot{y}(t) &= \frac{\Omega}{\omega_n^2} \frac{2\zeta r \sin(\Omega t) + (1 - r^2) \cos(\Omega t)}{(1 - r^2)^2 + (2\zeta r)^2} + \frac{r}{\omega_n^2 ((1 - r^2)^2 + (2\zeta r)^2)} \\ &\quad \times \left[\omega_d e^{-\zeta\omega_n t} \left(-2\zeta \sin(\omega_d t) + \omega_n (2\zeta^2 - (1 - r^2)) \frac{\cos(\omega_d t)}{\omega_d} \right) \right. \\ &\quad \left. - \zeta\omega_n e^{-\zeta\omega_n t} \left(2\zeta \cos(\omega_d t) + \omega_n (2\zeta^2 - (1 - r^2)) \frac{\sin(\omega_d t)}{\omega_d} \right) \right] \\ &= \frac{r}{\omega_n} \frac{(1 - r^2) \cos(\Omega t) + 2\zeta r \sin(\Omega t)}{(1 - r^2)^2 + (2\zeta r)^2} + \frac{r}{\omega_n^2 ((1 - r^2)^2 + (2\zeta r)^2)} \\ &\quad \times \left[(\omega_n (2\zeta^2 - (1 - r^2)) - 2\zeta^2 \omega_n) \cos(\omega_d t) \right. \\ &\quad \left. + \left(-2\zeta\omega_d - \frac{\zeta\omega_n^2 (2\zeta^2 - (1 - r^2))}{\omega_d} \right) \sin(\omega_d t) \right] \\ &= \frac{r}{\omega_n} \frac{(1 - r^2) \cos(\Omega t) + 2\zeta r \sin(\Omega t)}{(1 - r^2)^2 + (2\zeta r)^2} + \frac{r e^{-\zeta\omega_n t}}{\omega_n^2 ((1 - r^2)^2 + (2\zeta r)^2)} \\ &\quad \times \left[-\omega_n (1 - r^2) \cos(\omega_d t) \right. \\ &\quad \left. + (-2\zeta\omega_d^2 - \zeta\omega_n^2 (2\zeta^2 - (1 - r^2))) \frac{\sin(\omega_d t)}{\omega_d} \right] \\ &= \frac{r}{\omega_n} \frac{(1 - r^2) \cos(\Omega t) + 2\zeta r \sin(\Omega t)}{(1 - r^2)^2 + (2\zeta r)^2} + \frac{r e^{-\zeta\omega_n t}}{\omega_n^2 ((1 - r^2)^2 + (2\zeta r)^2)} \\ &\quad \times \left[-\omega_n (1 - r^2) \cos(\omega_d t) \right. \\ &\quad \left. + \zeta\omega_n^2 (-2(1 - \zeta^2) - 2\zeta^2 + (1 - r^2)) \frac{\sin(\omega_d t)}{\omega_d} \right] \\ &= \frac{r}{\omega_n} \frac{(1 - r^2) \cos(\Omega t) + 2\zeta r \sin(\Omega t)}{(1 - r^2)^2 + (2\zeta r)^2} + \frac{r e^{-\zeta\omega_n t}}{\omega_n^2 ((1 - r^2)^2 + (2\zeta r)^2)} \\ &\quad \times \left[-\omega_n (1 - r^2) \cos(\omega_d t) + \zeta\omega_n^2 (-2 + (1 - r^2)) \frac{\sin(\omega_d t)}{\omega_d} \right] \\ &= \frac{r}{\omega_n} \frac{(1 - r^2) \cos(\Omega t) + 2\zeta r \sin(\Omega t)}{(1 - r^2)^2 + (2\zeta r)^2} + \frac{r e^{-\zeta\omega_n t}}{\omega_n ((1 - r^2)^2 + (2\zeta r)^2)} \end{aligned}$$

$$\times \left[- (1 - r^2) \cos (\omega_{\text{d}} t) - \zeta \omega_{\text{n}} (1 + r^2) \frac{\sin (\omega_{\text{d}} t)}{\omega_{\text{d}}} \right] \quad (4.24)$$

Substituting equations (4.23) and (4.24) in (4.21) yields

$$\boxed{\frac{r}{\omega_{\text{n}}} \frac{(1 - r^2) \cos (\Omega t) + 2 \zeta r \sin (\Omega t) - e^{-\zeta \omega_{\text{n}} t} \left[(1 - r^2) \cos (\omega_{\text{d}} t) + \zeta \omega_{\text{n}} (1 + r^2) \frac{\sin (\omega_{\text{d}} t)}{\omega_{\text{d}}} \right]}{(1 - r^2)^2 + (2 \zeta r)^2} \xleftrightarrow{\mathcal{L}} \frac{\Omega s}{(s^2 + \Omega^2) (s^2 + 2 \zeta \omega_{\text{n}} s + \omega_{\text{n}}^2)}} \quad (4.25)$$

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Chapter 5

Reference Management Software

Reference management software [4] is citation management software or personal bibliographic management software is software for scholars and authors to use for recording and utilising bibliographic citations (references) [5]. Once a citation has been recorded, it can be used time and again in generating bibliographies, such as lists of references in scholarly books, articles and essays. The development of reference management packages has been driven by the rapid expansion of scientific literature. Among popular reference management software are:

JabRef, a BibTeX management cross-platform software for use with L^AT_EX/L_YX.

Endnote, a management software suitable for use with MS Word

Zotero, a cross-platform web-based management software suitable for L^AT_EX/L_YX, MS Word, LibreOffice and others.

Comparisons of these software are available in [6].

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Chapter 6

Vector Graphics

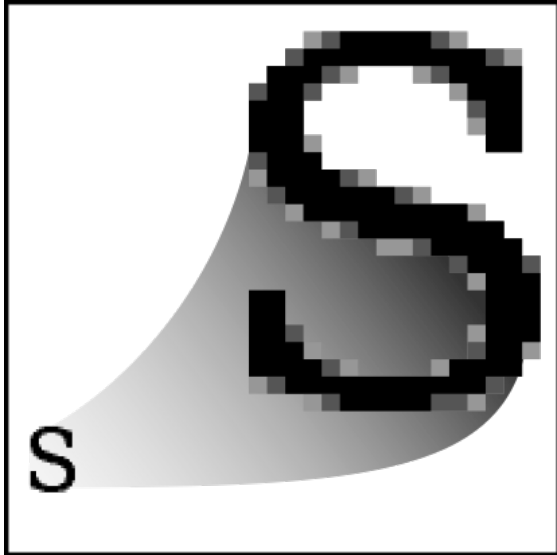
6.1 Raster vs Vector Graphics

Graphics Formats

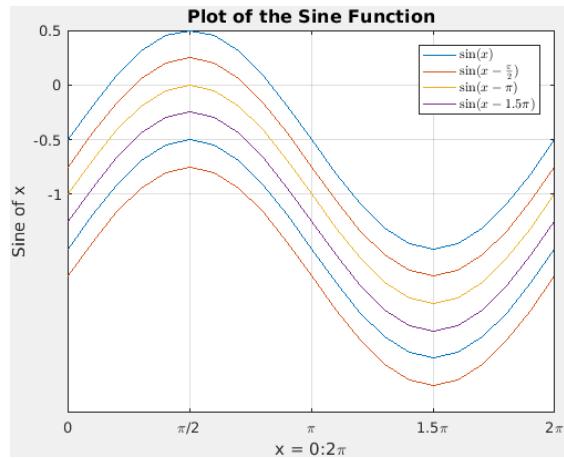
Raster		Vector	
.bmp	Uncompressed	.pdf	Compressed
.png	Loose-less compression	.eps	
.jpg	Lossy compression	.emf	Compatible with MS office
		.svg	
⋮		⋮	

6.2 Vector Graphics Editors

- Adobe Illustrator (*de facto* standard; bloated)
- Corel Draw (bloated)
- Inkscape (light, free, open source, cross-platform and popular; my favorite)
- LibreOffice Draw
- ...



(a) Letter



(b) Matlab figure

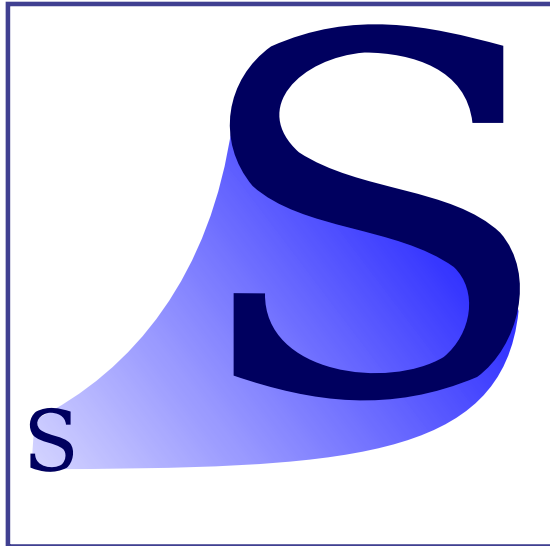


(c) Tiger

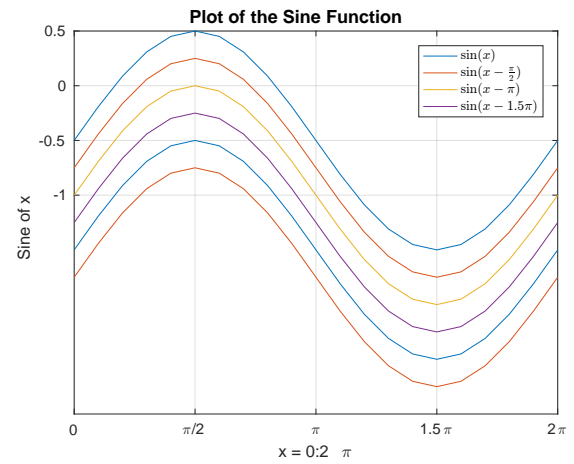


(d) Face

Figure 6.1: Sample raster graphics. This figure is forced to be on a left page for easier comparison with figure 6.2 on the opposite page.



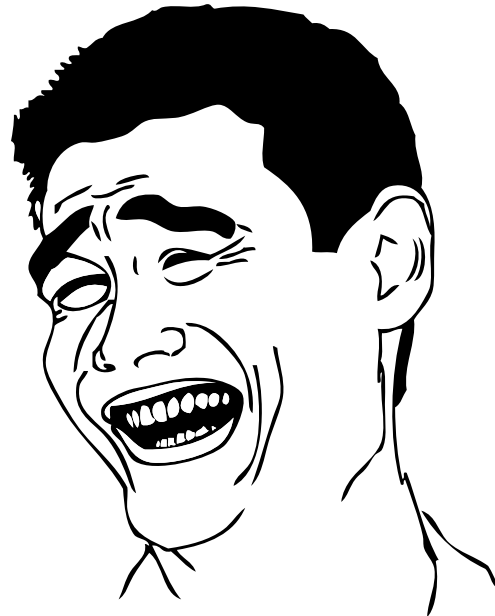
(a) Letter



(b) Matlab figure



(c) Tiger



(d) Face

Figure 6.2: Vector graphics version of figure 6.1

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Chapter 7

Inkscape; Free and Open Source Vector Graphics Editor

Inkscape Features

- Open source
- Cross platform
- Free
- Has a big community, i.e.,
 - it is mature enough
 - when you encounter a problem, google it. Most likely you will find others had encountered it and found a solution
- Much much powerful than Ms-Word or Ms-Power point sketching capabilities
- Has several plugins that greatly expand its capabilities

Inkscape Capabilities

Inkscape is based on bezier curves. That is, a curve is defined using four information, **start**, **end**, **start tangent** and **end tangent**.

- Additionally, you can draw and edit:
 - straight lines
 - circles/arcs/ellipses
 - text
 - \LaTeX formulas
 - function curves
 - ...

7.0.1 Import Graphics from pdf

You can import vector graphics from pdf files, and even edit them, as shown in [7.1](#).

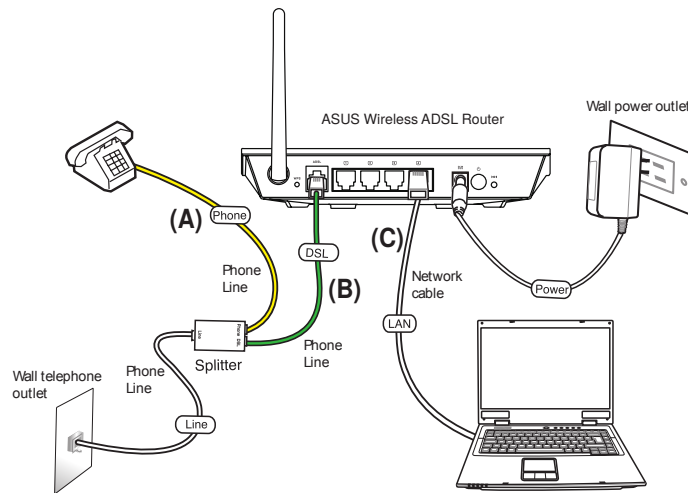


Figure 7.1: Vector graphic imported from the user guide of a home use ADSL router

7.1 Interesting Plug-ins

7.1.1 Function Plotter

- It is a built in plugins
- It uses bezier curves, same as Inkscape
- It calculates the function derivative and use it to adjust the curve slope
 - It produces very smooth curves using much less points than Matlab
 - You can still adjust/correct the curve manually

Figure 7.2 shows the plugin user interface, and the resulting curve. Figure 7.3 shows a more comprehensive example.

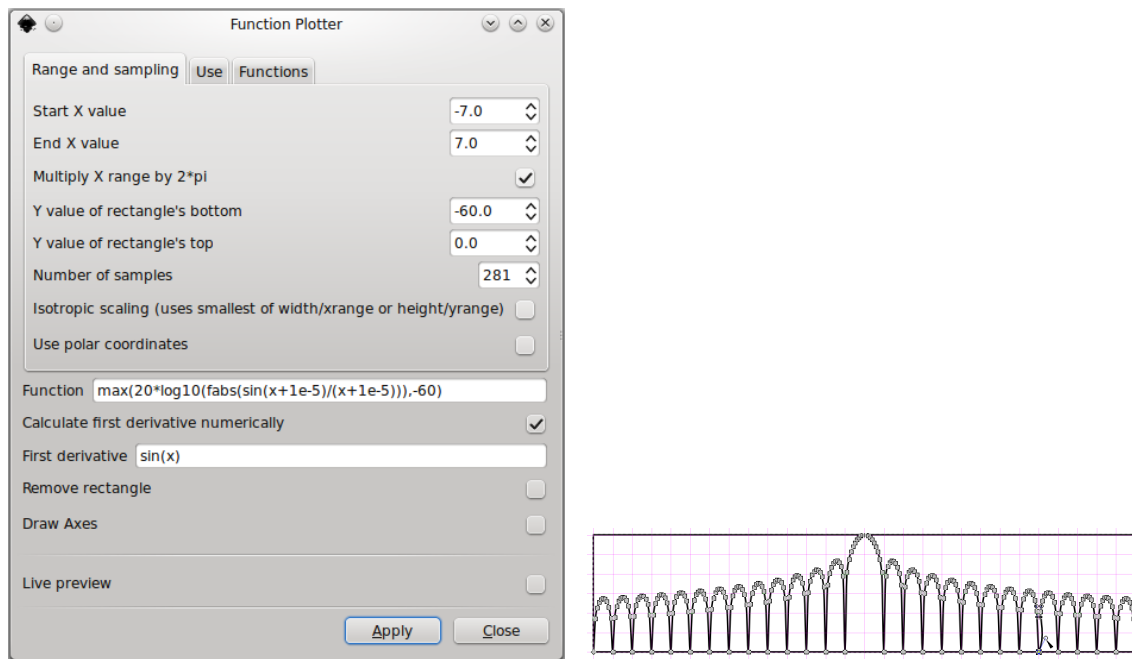
7.1.2 TextText

It allows you to write/edit $\text{L}^{\text{A}}\text{T}_{\text{E}}\text{X}$ formulas inside Inkscape.

7.1.2.1 Installing TextText on MS Windows (all versions, including 32 & 64 bit)

Follow the instructions of <http://people.orie.cornell.edu/jmd388/design/guides/texttext.pdf>. That is:

1. Install Inkscape (the 32-bit version)
2. Install TextText from https://pav.iki.fi/_downloads/texttext-0.4.4.exe
3. Install 32 or 64 bit versions of ghostscript, imagemagick, pstoeedit
4. Make sure the following paths are added to the the “Path” environment variable:
 - C:\Program Files\gs\gs9.xx\lib



(a) Function Plotter user interface

(b) Curve generated by Function Plotter

Figure 7.2: The Function Plotter plugin

- C:\Program Files\gs\gs9.xx\bin
 - C:\Program Files\ImageMagick
 - C:\Program Files\ghostgum\pstoedit
5. Download the file <http://people.orie.cornell.edu/jmd388/design/guides/texttext.zip>
 - (1) Replace the “C:\Program Files (x86)\Inkscape\share\extensions\texttext.py” file with the file in the texttext.zip file
 - (2) Extract¹ the “site-packages.zip” file in the texttext.zip file to “C:\Program Files (x86)\Inkscape\python\Lib\site-packages”

7.1.2.2 Installing TexText on Linux

Installation on Linux is too easy and straight forward. Just follow the instructions at Tex-Text web page; <https://pav.iki.fi/software/texttext/>.

7.2 Learning Inkscape

- **Explore** menus and toolbars
- **Official manual** [7] is very good and detailed
 - Chapters 2 includes 10 examples
 - * The first 3 examples are enough for a good start

¹You must have administrator privileges to to this.

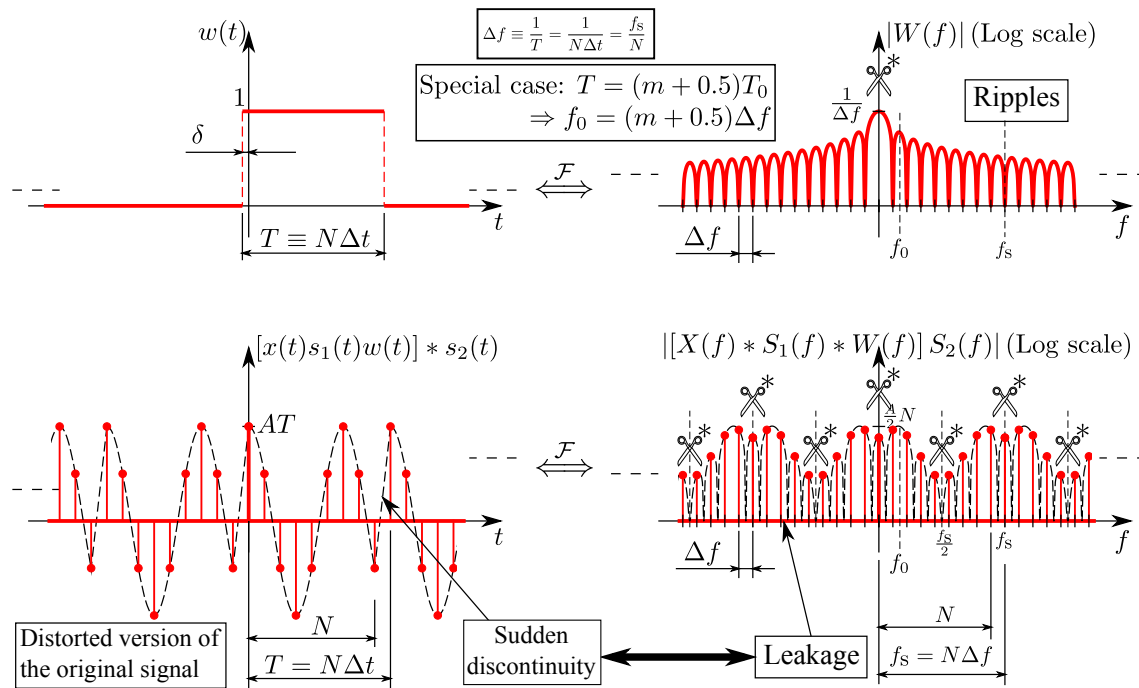


Figure 7.3: Figure illustrating the capabilities of “Function Plotter” and “TextText” plug ins.

– Chapters 5 explains editing

* Surf it fast

- **Help menu** includes tutorials, FAQ, ...
- <http://inkscapetutorials.org/>

Chapter 8

Including Program Codes

There is the listings \LaTeX package which greatly simplifies adding program codes. Details are available in [1, chapter 8]. For example, codes [A.1](#) and [A.2](#) are used to plot figure [4.1\(a\)](#).

Code [A.3](#) on the other hand exports a Matlab figure a pdf file and crops it by removing white margins. Cropping is accomplished by calling a Perl program called “pdfcrop”. This program, ships with both MiK \TeX and T \TeX Live \LaTeX implementations. To use this program, Perl is needed to be installed¹.

¹“Strawberry Perl” is a sample open-source Perl implementation for Microsoft Windows.

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Chapter 9

Nomenclature

If you defined a nomenclature entry twice, it results in an error (Lonely `\item`—perhaps a missing list environment.).

9.1 Problems with Arabic

Nomenclature (and may be index too) sometimes causes problems in Arabic documents. As a workaround (assuming your thesis file name is “Thesis”):

1. `pdflatex` the Thesis.tex file twice (or as needed)
2. manually edit the *.nlo file and modify as follows

modify lines similar to this

```
\nomenclatureentry{aVI@[{VI}]\begingroup Visual  
Inspection\nomeqref {1.0}|nompageref}{\if@rlmain \I {1}\else  
\textLR {1}\fi }
```

to this

```
\nomenclatureentry{aVI@[{VI}]\begingroup Visual  
Inspection\nomeqref {1.0}|nompageref}{1}
```

3. Run the command

```
makeindex 'Thesis.nlo' -s nomencl.ist -o 'Thesis.nls'
```

4. `pdflatex` the Thesis.tex file once more (or as needed)

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Appendix A

Matlab Codes

Code A.1: SDOF_Free_Response_Visc_main

```
1 function SDOF_Free_Response_Visc_main()
2 clc
3 close all
4
5 set(groot,'DefaultAxesColorOrder',[0,0,1;0,0,0;1,0,0;0,0.5,0;1,0,1])
6 set(groot,'DefaultAxesLineStyleOrder','-|--|-.')
7 set(groot,'DefaultLineLineWidth',1);
8 set(groot,'DefaultAxesFontName','Times')
9
10 w_n=1;
11 x0=-1;
12 v0=0;
13
14 zeta_vec=[0,.1,.2,.4,1/sqrt(2),1,2];
15 legend_string={'$\zeta=0$', '$\zeta=0.1$', '$\zeta=0.2$', '$\zeta=0.4$', '$\zeta=1/\sqrt{2}$', '$\zeta=1$', '$\zeta=2$'};
16
17 t_vec=linspace(0,4*pi,500);
18
19 figure
20 hold on
21 for n=1:length(zeta_vec)
22     x_vec=SDOF_Free_Response_Visc(w_n,zeta_vec(n),x0,v0,t_vec);
23     plot(w_n*t_vec,x_vec)
24 end
25
26 title('$x(t)$ for $\omega_n=1$, $x_0=-1$ and $\dot{x}_0=0$', 'interpreter','latex');
27 xlabel('$\omega_n t$', 'interpreter','latex');
28 legend(legend_string,'interpreter','latex','Location','SouthEast');
29
30 grid on
31 ax=gca;
32 ax.XTick=0:pi:4*pi;
```

```

33 ax.XTickLabel={'0','\pi','2\pi','3\pi','4\pi'};
34 ax.XAxis.MinorTickValues=setdiff(0:pi/2:4*pi,0:pi:4*pi);
35 ax.XMinorGrid='on';
36 ax.XLim=[0,4*pi];
37
38 set(groot,'DefaultAxesColorOrder','remove')
39 set(groot,'DefaultAxesLineStyleOrder','remove')
40 set(groot,'DefaultLineLineWidth','remove');
41 set(groot,'DefaultAxesFontName','remove')
42
43 export_figure(gcf, '', {'SDOF_FreeResponse'})

```

Code A.2: function SDOF_Free_Response_Visc.m

```

1 function x_vec=SDOF_Free_Response_Visc(w_n, zeta, x0, x_dot_0, t_vec)
2
3 if zeta~=1
4     w_d=w_n*sqrt(1-zeta^2);
5     x_vec=exp(-zeta*w_n*t_vec).*(x0*cos(w_d*t_vec)+(zeta*w_n*x0+
        x_dot_0)*sin(w_d*t_vec)/w_d);
6 else
7     x_vec=exp(-w_n*t_vec).*(x0+(w_n*x0+x_dot_0)*t_vec);
8 end

```

Code A.3: function export_figure

```

1 function export_figure(fig_handle_vec, ...
2     Expand,filenames,resolution,pictureFormat) %
3     Optional arguments
4
5 if nargin<2
6     Expand='';
7 end
8
9 if nargin<4
10    resolution=600;
11 elseif isempty(resolution)
12    resolution=600;
13 end
14
15 if nargin<5
16    pictureFormat={'pdf'};
17 else
18     if ~iscell(pictureFormat)
19         error('pictureFormat must be cell array of strings.')
20     end
21 end

```



```

22 printFlag=cell(size(pictureFormat));
23 for n=1:length(pictureFormat)
24     if strcmpi(pictureFormat{n},'emf')
25         if ispc
26             printFlag{n}='meta';
27         else
28             error('Matlab cannot export emf except under Windows. ');
29         end
30     else
31         printFlag{n}=lower(pictureFormat{n});
32     end
33 end
34
35 if min(size(fig_handle_vec,1),size(fig_handle_vec,2))~=1,
36     error('h must be 1-D vector'),
37 end
38
39 if ~iscellstr(filenamees)
40     error('filenamees must be a cell string of the same length as h_vec');
41 end
42
43 if nargin>2
44     if length(fig_handle_vec)~=length(filenamees)
45         error('h & filenamees must be of the same length');
46     end
47 end
48
49 if ~isempty(Expand)
50     if ischar(Expand)
51         if (~strcmpi(Expand,'||') && ~strcmpi(Expand,'=='))
52             error('you must input ''||'' or ''=='')
53         end
54     end
55 end
56
57 for i=1:length(fig_handle_vec)
58     f_OriginalUnit=get(fig_handle_vec(i),'Units');
59     set(fig_handle_vec(i),'papertype','A4');
60     if ~isempty(Expand)
61         if ischar(Expand)
62             if strcmpi(Expand(1:2),'||')
63                 set(fig_handle_vec(i),'PaperOrientation','portrait');
64             elseif strcmpi(Expand(1:2),'==')
65                 set(fig_handle_vec(i),'PaperOrientation','landscape');
66             end
67         end
68     end
69 end

```

```

67     end
68
69     if ischar(Expand)
70         if strcmpi(Expand,'||') || strcmpi(Expand,'==')
71             a=get(fig_handle_vec(i),'papersize');
72             set(fig_handle_vec(i), 'PaperPositionMode', 'manual');
73             set(fig_handle_vec(i),'PaperPosition',[0 0 a(1) a(2)])
74             ;
75             set(fig_handle_vec(i),'Units',get(fig_handle_vec(i),'
76                 PaperUnits'));
77             set(fig_handle_vec(i),'Position',[0 0 a(1) a(2)]);
78             set(fig_handle_vec(i),'Units',f_OriginalUnit);
79             set(0,'CurrentFigure',fig_handle_vec(i)),
80             drawnow
81         else
82             set(fig_handle_vec(i), 'PaperPositionMode', 'auto');
83         end
84     elseif isnumeric(Expand)
85         pos=get(fig_handle_vec(i),'PaperPosition');
86         set(fig_handle_vec(i), 'PaperPositionMode', 'manual');
87         set(fig_handle_vec(i), 'PaperPosition', [pos(1:2),pos(3:4)*
88             Expand]);
89     end
90 end
91
92 for i=1:length(fig_handle_vec),
93     for n=1:length(printFlag)
94         if nargin<3
95             print(['-r',int2str(resolution)], '-painters', ['-d',
96                 printFlag{n}], ['-f',int2str(double(fig_handle_vec(i)))
97                 ]);
98             %print(['-r',int2str(resolution)], '-painters', ['-d',
99                 printFlag{n}], ['-f',int2str(get(fig_handle_vec(i),'
100                 Number'))]);
101         else
102             print(['-r',int2str(resolution)], '-painters', ['-d',
103                 printFlag{n}], ['-f',int2str(double(fig_handle_vec(i)))
104                 ],[filenames{i},['.',pictureFormat{n}]]]);
105         % print(['-r',int2str(resolution)], '-painters', ['-d',printFlag{n}
106             }, ['-f',int2str(get(fig_handle_vec(i),'Number'))],[filenames{i}
107             },['.',pictureFormat{n}]]]);
108     end
109 end
110
111 end
112
113 % %If "strawberry perl" and Miketex is installed

```

```

104 if nargin>=3 %&& ispc
105     temp_env=getenv('LD_LIBRARY_PATH');
106     setenv('LD_LIBRARY_PATH', '')
107     for n=1:length(pictureFormat)
108         if strcmpi(pictureFormat{n},'pdf')
109             for i=1:length(fig_handle_vec),
110                 system(['pdfcrop"',filenames{i},'.pdf"',filenames{i}
111                     },'.pdf"']);
112             end
113             break;
114         end
115     end
116     setenv('LD_LIBRARY_PATH', temp_env)
117 end

```

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This page intentionally left blank!

Index

Adobe Illustrator, [21](#)

bmp, [21](#)

Corel Draw, [21](#)

emf, [21](#)

eps, [21](#)

Function plotter, [26](#)

IDE, [6](#)

Inkscape, [21](#), [25](#)

jpg, [21](#)

L^AT_EX, [3](#)

L_YX, [7](#)

MiKTeX, [6](#)

pdf, [21](#)

png, [21](#)

proText, [6](#)

Raster graphics, [21](#)

svg, [21](#)

TeXText, [26](#)

Tex Live, [6](#)

Vector graphics, [21](#)

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