Scientific Writing and Presentations for PhD Students

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Outline

- Scientific Writing: article, oral presentation, poster presentation
- LaTeX and associated softwares
- Practice 1: Writing an article in LaTeX
- Practice 2: Making a poster with LaTeX/Beamer
- Oral presentation

PhD in France

- Three years of research, after Master’s degree (Bac+5)
  - courses
  - survey
  - subject
  - research
  - experiments
  - analysis
  - publish + present
  - draft your thesis
  - submit to reviewers
  - defend your thesis

As a scientist, you are a professional writer...

About me

- Professor at L2S, Dept. Telecom., CentraleSupélec
- Research area: Information theory, wireless networking, signal processing
- Editor of IEEE Transactions on Wireless Communications (Impact factor 5.88)
Typical Research Process

- Choosing the topic: new, “interesting”, important.
- Establish the Hypothesis: A testable prediction
- Definition of the problem
- Empirical research: Gathering, analysis, and interpretation of data
- Non-empirical research (e.g. math): analysis
- Test / proof, revising of hypothesis
- Conclusion, reiteration if necessary

Research Publication

- Submit to journal/conference
  - Peer review
  - Revisions, iterations…
- Dissemination:
  - Oral presentation: conference, invited talk
  - Poster presentation

Success in Research

Get cited by others
- Not the quantity, but the influence, matters
  - H-index
  - i-10 index
- Writing and presenting clearly is crucial
  - Let your peers understand your work and then use it

Qualities Expected from a PhD

- Excellence in a target area
- Up to date with the research progress
- Autonomy with respect to investigation topics
- Creativity: generating new ideas
- Good written and oral communication skills
Outline of Today’s Lecture

- General Advices
- Conference papers and presentations
- Journal papers
- Making slides & posters

First Advices on Strategies

- Make sure your results are correct
  
  The first principle is that you must not fool yourself and you are the easiest person to fool. —Richard P. Feynman

- Avoid incremental research
- Target only top conferences/journals
- “Exploit” your advisor, but smartly

An article as a story

**SUCCESS**

- Simple
- Unexpected
- Concrete
- Credible
- Energetic
- Stories

“Simple”

Everything should be made as simple as possible, but not simpler. — Albert Einstein

- Simple ideas stick (natural selection, channel capacity, …)
- Simple writings read well
- Simple is not simplistic, nor easy/trivial

* J. Schimel, “Writing Science”
“Unexpected”

- From incremental to novel
- Contribution is the “unknown”
- Identifying the knowledge gap (“unknown”) creates curiosity
- Filling the knowledge gap creates novelty

“Concrete”

... the surest way to arouse and hold the reader’s attention is by being specific, definite, and concrete — Strunk and White

- Ideas are often abstract, but
  - they build on concrete data and facts
  - they are more convincing with concreteness
- Use concrete examples to convey the ideas

“Credible”

Science writing that isn’t credible is science fiction...

- Describe clearly the method, data, and sources
- Comprehensive citations of previous related works
- Build on concreteness

“Energetic”

Don’t say the old lady screamed. Bring her on and let her scream. — Mark Twain

- Energize the writing
  - avoid passive voice
  - avoid vocabulary seldom used in spoken language
  - be professional without being pedantic
“Stories”

O C A R

- Opening: characters (subjects), background/context
- Challenge: what to accomplish, what questions to answer
- Action: what has happened (in a paper), or what you hope to happen (in a proposal)
- Resolution: What is the result of the action?

Avoid Passive Voice

With an active verb, the subject is doing something. With a passive verb, the subject is just letting it happen.

— Stephen King

Unless...

- Control the **perspective**: “Variable electric fields are produced by a magnetospheric source.”
- **Hide** the actor: “mistakes were made…”

Avoid Fuzzy Verbs

Colorful language is for fictions...

Science writing is supposed to be clear

<table>
<thead>
<tr>
<th>fuzzy verbs (weak)</th>
<th>Occur</th>
<th>Facilitate</th>
<th>Conduct</th>
<th>Implement</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Affect</td>
<td>Perform</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>action verbs (strong)</th>
<th>Increase/Decrease</th>
<th>React</th>
<th>Accelerate</th>
<th>Migrate</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Accomplish</td>
<td>Create</td>
<td>Invade</td>
<td>Disrupt</td>
</tr>
</tbody>
</table>

No one wants flowers of eloquence or literary ornaments in a research article.
— R. B. McKerrow

Avoid Nominalization

Ex: We conducted an investigation of the impact of phase noise.

We investigated the impact of phase noise.

<table>
<thead>
<tr>
<th>verb</th>
<th>adjective</th>
</tr>
</thead>
<tbody>
<tr>
<td>Move</td>
<td>Different</td>
</tr>
<tr>
<td>Diff</td>
<td>Difficult</td>
</tr>
<tr>
<td>Suggest</td>
<td>Suggestion</td>
</tr>
<tr>
<td>Interact</td>
<td>Interaction</td>
</tr>
<tr>
<td>Develop</td>
<td>Development</td>
</tr>
<tr>
<td></td>
<td>Different</td>
</tr>
<tr>
<td></td>
<td>Difficult</td>
</tr>
<tr>
<td></td>
<td>Ability</td>
</tr>
<tr>
<td></td>
<td>Capable</td>
</tr>
<tr>
<td></td>
<td>Capability</td>
</tr>
<tr>
<td></td>
<td>Similar</td>
</tr>
<tr>
<td></td>
<td>Similarity</td>
</tr>
</tbody>
</table>
Avoid Jargons

<table>
<thead>
<tr>
<th>Jargon</th>
</tr>
</thead>
<tbody>
<tr>
<td>A term that refers to a schema that the reader does not hold.</td>
</tr>
<tr>
<td>A term for which there is an adequate plain language equivalent.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Technical term</th>
</tr>
</thead>
<tbody>
<tr>
<td>A term that refers to a schema that the reader does hold.</td>
</tr>
<tr>
<td>A term for which there is no adequate plain language equivalent.</td>
</tr>
</tbody>
</table>

- Relative to your audience
- Introduce the term in the right place

• **Beginning** of the sentence: You assume that every reader knows and understands the term. Risk of jargon
• **End** of the sentence: You define the new term for everyone. Risk of appearing ignorant
• **Middle** of the sentence: You assume that most readers know the term.

This idea that excited states relax with rates determined by the solute-solvent system's ordinary energy fluctuations, commonly called linear response theory, is a critical component in the success of transition-state theories of chemical reaction rates in liquids.

Putting it all together

- Structure: get the structure of the story into shape
- Clarity: ensure that your ideas are clear and concrete
- Flow: make the ideas flow, linking one thought to the next
- Language: make it sound good

Science Writing: IMRD

- **Introduction**
  - Background & motivation
  - State of the art
  - Your findings (in simple form)
- **Materials and methods**
  - Assumptions
  - Proposed scheme
- **Results**
  - Analytical results with proofs
  - Simulation/experiment results (figures/tables)
- **Discussions**
  - Interpretations of the results
  - Consequences, take-home messages
Other structures

- **Lead/Development/Resolution** (e.g. magazines)
  - Faster: attract attention for the impatient
- **Lead/Development** (e.g. newspapers)
  - Fastest: start with a sentence or two for the whole story

Adapt your style to the targeted readers.

Standard Article Structure

<table>
<thead>
<tr>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abstract</td>
</tr>
<tr>
<td>- Introduction</td>
</tr>
<tr>
<td>- Model &amp; Method</td>
</tr>
<tr>
<td>- Results</td>
</tr>
<tr>
<td>- Discussions</td>
</tr>
<tr>
<td>- Conclusion</td>
</tr>
<tr>
<td>- Appendix</td>
</tr>
<tr>
<td>- References</td>
</tr>
</tbody>
</table>

Choosing a Title

- **Short&general vs. long&specific**
  - Being too general may not be informative (tutorial papers)
  - Being too specific may imply narrow scope
- **Catchy/fancy titles can be good only if the work is original**
  - Careful with “optimal”, “universal”,...
  - Avoid being too grand: “revolutionary”, “paradigm shift”
Writing the Abstract

- Only part that reader sees when searching through databases
- May be the only part used by committee members to identify potential reviewers
- Short and concise version of the “MRD” part of IMRD
- Use as few as one to two sentences for each of the “MRD” parts
- Avoid equations
- Reader will stop at the abstract if badly written

Putting Adequate References

- References and state of the art position your work
  - Origine of the problem, progress
  - Justification of your work: why is it important/interesting/new
- Adequate references prove that you are familiar with the field
  - Reviewers are most likely to be experts
  - Leaving out important references related to the topic discredits your work
- Always acknowledge previous contributions, analyse the cited works
- Avoid uninvited criticisms on “bad” papers, simply do not cite them

Presenting Results

- Highlight the main result, make it as visible as possible
  - State it in a self-contained way
- Choose the best representation of the results
  - Graphs and tables can be used (again, should be self-contained)
  - “Compress” them such that your message is easy to spot
- Graphs/tables are usually just support for theoretical results, stand as proofs only when you provide a way to reproduce them

Use a Graph when Data Shows a Pronounced Trend

- Each graph should be simple and not overcharged
- Text should be readable, preferably with the same font and size as the main text
- The axis range should be adjusted appropriately
- Make curves well distinguishable even printed B&W (test it before submission)
Which one is better?

Further Advices

- Use technical English, be scientific
- Abbreviations
  - Use standard ones (DNA, GDP, LTE, SNR)
  - Avoid creating your own ones (with moderation, 2 or 3 is OK)
- Paper length
  - Respect the page limit if there is any
  - Keep your paper concise: people are more likely to read short papers
  - Lengthy proofs, if not the main contribution, should be put in the appendix

Purposes of a Conference

- Present your work to others, discuss with them
- Get to know on-going works, maybe new topics
- Networking with people in the same community
- Advertise yourself

Writing a Conference Paper

- Can either be a new idea, or extraction of a long paper
- Usually four to ten pages
- Present only essential results
  - Abstract should be short but concise
  - Sketches of proofs, extended version should be available
- But be convincing, highlight the novelty and contribution
  - Reviewers spend as few as 10 minutes to review your paper!
  - Due to the large amount of papers, reviewing process may be chaotic
  - There is no rebuttal for conference in general …
Choosing an Appropriate Journal

- Journal papers are generally more cited than conference papers
- Each journal has a well-defined orientation and target author/readership
- Choose the best one (you should know which): think about citation
- Better to be familiar with papers in your field from this journal

Writing a Journal Paper

- A journal paper must contain substantial contribution
  - A comprehensive survey of the state of the art
  - Originality/novelty beyond the state of the art
  - Accuracy and rigour (everything has be proved, correctly)
  - Conciseness (avoid being unnecessarily lengthy)

Presentation

Preparing the slides

- Know your audience
- Less is more
- Don’t overload your slides
- Organise your talk into sections
- Ensure readability
- Use simple visuals
- Check your spelling, typos are distracting
Steps

- Choose your software
  - LaTeX+Beamer, Keynote, Powerpoint
- Define the structure
  - Title, story, outline
- Fill in the elements
  - From your papers, or new materials
- Revise
- Rehearse, Iterate…

During the presentation

- Speak up
- Take your time
- Straight to the essence
- Talk to the audience
- Stick to your time frame

Poster

Like presentation but …

<table>
<thead>
<tr>
<th>pros</th>
<th>cons</th>
</tr>
</thead>
<tbody>
<tr>
<td>People are likely to see your poster</td>
<td>People “can” leave</td>
</tr>
<tr>
<td>More interactive</td>
<td>More competition</td>
</tr>
<tr>
<td>All materials inside an A1 paper</td>
<td>Limited space in A1 paper</td>
</tr>
<tr>
<td>Can hang in your department</td>
<td>You have to repeat the same speech</td>
</tr>
</tbody>
</table>
Preparing the poster

- Know your audience
- Less is more
- Readability is the key
- Use simple visuals

Steps

- Pick your software
  - LaTeX Beamer, Pages, Adobe Illustrator or InDesign, Powerpoint
- Define the structure
  - Start from your paper
- Fill in the elements
- Print an A4 draft, revise
- Iterate...

Some “rules”

- Titles readable from far away
- Body text readable for audience
- Limited number of words: up to 250
- Natural order of the blocks
- Limited number of colors
- Clean background
• avoid primary colors
• attract attention
• but not in a good way

use dark fonts on light background

avoid busy background
Reduced sized subset, \( I_{n} \leq h_{2} + I_{n} - \log |Z| \).
Before Writing

- You need 2-3 months for the writing
- Make the table of contents first
  - What is the topic/theme of your thesis
  - Select the materials that you have
  - Discuss with your supervisor
- Make a time table
- Determine the format (template) and pick a software

Don’t Start from Scratch

- Put the published papers in the corresponding chapters
- Remove the redundancy, unify the notations
- Write the missing parts
- Make the conclusion clear, concise, and informative
- Write introduction last
- Iterate, improve, spell check

Working with LaTeX

But why?
LaTeX

pronounced «Lah-tech» or «Lay-tech»

... is a sophisticated document preparation system

- Stylistic uniformity
- Bibliography support
- Sophisticated structuring abilities
- Convenient to typeset math equations (!!)
- Reference tracking
- Highly extendible capabilities

LaTeX is not a word processor!

- With a word processor, you spend valuable time agonising over what font size to make the section headings.
  - With LaTeX, you just tell it to start a new section.

- With a word processor, changing the formatting means you have to change each instance individually.
  - With LaTeX, you just redefine the relevant commands.

- With a word processor, you have to carefully match any provided templates.
  - With LaTeX, you can be sure you’ve fit the template, and switch templates easily.

LaTeX is not a word processor!

Presentation shouldn’t get in the way of content.

The LaTeX system: What you need

- A LaTeX distribution: can be freely downloaded
  - TeX Live, MikTeX (Windows), or MacTeX (Mac OS)

- Text editor, some are compatible with LaTeX
  - Emacs, Vim+LaTeXsuite, TeXShop, TeXnicCenter, WinEdt

- PDF viewer
  - Acroread(any), xpdf or Okular(Linux), Skim, etc.
Compilation

- .tex files are compiled with commands
- use “latex toto.tex” ⇒ toto.dvi to be viewed
- use “dvips toto.dvi” ⇒ toto.ps to be printed
- or, use “pdflatex toto.tex” ⇒ toto.pdf

You can use GUI instead, just click the buttons

Basic Structure of a LaTeX File

\documentclass[12pt,twoside]{amsart}
\usepackage{amsmath, amssymb}
\newtheorem{theorem}{Theorem}[section]
\begin{document}
\title{Your title}
\author{Your name} % & other info
\maketitle

\section{Introduction}
\subsection{Detailed introduction} % & more levels

\begin{thebibliography}{99}
\bibitem{UsefulCitation} Awesome Author, Famous Title, Good Publisher, 2003.
\end{thebibliography}
\end{document}

Documentclass

- \LaTeX{} has several templates, selected using \texttt{\documentclass}

<table>
<thead>
<tr>
<th>class</th>
<th>description</th>
</tr>
</thead>
<tbody>
<tr>
<td>article</td>
<td>for articles in scientific journals, presentations, short reports, program documentation, invitations</td>
</tr>
<tr>
<td>proc</td>
<td>a class for proceedings based on the article class</td>
</tr>
<tr>
<td>minimal</td>
<td>is as small as it can get. It only sets a page size and a base font. It is mainly used for debugging purposes</td>
</tr>
<tr>
<td>report</td>
<td>for longer reports containing several chapters, small books, Master’s and PhD theses</td>
</tr>
<tr>
<td>book</td>
<td>for real books</td>
</tr>
<tr>
<td>beamer</td>
<td>the \LaTeX{} version of Powerpoint</td>
</tr>
</tbody>
</table>

Document Class Options

<table>
<thead>
<tr>
<th>options</th>
<th>description</th>
</tr>
</thead>
<tbody>
<tr>
<td>10pt, 11pt, 12pt</td>
<td>Sets the size of the main font in the document. Default is 10pt</td>
</tr>
<tr>
<td>a4paper, letterpaper,</td>
<td>Defines the paper size. Default is letterpaper others</td>
</tr>
<tr>
<td>titlepage,</td>
<td>Specifies whether a new page should be started after the document title or not</td>
</tr>
<tr>
<td>nottompage</td>
<td>article class does not start a new page by default, while report and book do</td>
</tr>
<tr>
<td>onecolumn, twocolumn, landscape, landscape</td>
<td>Instructs \LaTeX{} to typeset the document in one or two columns</td>
</tr>
<tr>
<td>openright, openany</td>
<td>Changes the layout of the document to print in landscape mode</td>
</tr>
<tr>
<td></td>
<td>Makes chapters begin either only on right hand pages or on the next page available. This does not work with the article class, as it does not know about chapters. The report class by default starts chapters on the next page available and the book class starts them on right hand pages</td>
</tr>
</tbody>
</table>
LaTeX commands are case sensitive
They start with a backslash \ and then have a name consisting of letters only
Command names are terminated by a space
Some commands require a parameter, which has to be given between curly braces { } after the command name
Some commands take optional parameters, which are inserted after the command name in square brackets [ ]
The % character is used to comment out a line

Syntax

Declarations and Environments

- Are stated once
- Take effect until further notice
- Ex. \documentclass, \small

Declarations

- Have matching begin and end declarations
- Ex. \begin{document} ...
  \end{document}

Environments

Arguments

- Required arguments
  - Are contained in curly braces
  - Must be included
  - Ex. \documentclass{article}

- Optional arguments
  - Are contained in square brackets
  - Can be left out
  - Ex. \documentclass[12pt]{article}

Packages

- Packages allow you to further customize LaTeX.
- The command: \usepackage{packagename}
- Packages available as *.sty files
- Some packages: graphicx, epsfig, geometry, fancyhdr, setspace, amsmath, listings, xcolor, url...

Comprehensive TEX Archive Network (CTAN) is the central source for all packages
www.ctan.org
Special Characters

- Another type of command
- Print non-standard characters or characters which usually mean something else
- Insert a backslash before these characters to get the desired result

\# $ % & _ { } \ - \ \$

Font Types

\begin{itemize}
\item \texttt{Text} → Text
\item \textit{Text} → Text
\item \textbf{Text} → Text
\item \textsf{Text} → Text
\item \textsc{Text} → Text
\item \textnormal{Text} → Text
\item \footnotesize Text → Text
\item \scriptsize Text → Text
\item \tiny Text → Text
\end{itemize}

Alignment and Spacing

input:
It does not matter whether you enter one or several spaces after a word.
An empty line starts a new paragraph.

output:
It does not matter whether you enter one or several spaces after a word.
An empty line starts a new paragraph.

- Whitespace characters, such as blank or tab, are treated uniformly as a space by \LaTeX
- Several consecutive whitespace characters are treated as one space
- Whitespace at the start of a line is generally ignored, and a single line break is treated as whitespace
- An empty line between two lines of text defines the end of a paragraph.
- Several empty lines are treated the same as one empty line.

Alignment and Spacing

- Alignment: \begin{center/flushright/flushleft} ... \end{center/flushright/flushleft}
- Margins
  - The default: between 1.5 inches and 1.875 inches
  - Setting margins with the “geometry” package: \usepackage[margin=0.5in]{geometry}
- Paragraphs and other breaks
  - Paragraphs are separated by a blank line.
  - Force a new line using \\, force a new page with \newpage
- Other spacing
  - \!, \, \> \: \;
  - \enspace, \quad, \qquad
  - \hspace{<len>}, \hphantom{<stuff>}, \hfill

Alignment and Spacing

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- Other spacing
  - \!, \, \> \: \;
  - \enspace, \quad, \qquad
  - \hspace{<len>}, \hphantom{<stuff>}, \hfill
What are Macros?

- LaTeX allows you to define or redefine commands
  \begin{verbatim}
  \newcommand{\name}{\num}{\definition}
  \end{verbatim}

- In fact, LaTeX itself is a set of macros on top of TeX

Changing lengths

\begin{verbatim}
\setlength{\command}{\length}
\end{verbatim}

Ex.
\begin{verbatim}
\setlength{\parindent}{1cm}
\setlength{\parskip}{1cm plus4mm minus3mm}
\end{verbatim}

Changing titles

Ex.
\begin{verbatim}
\renewcommand{\abstractname}{Summary}
\end{verbatim}

Bibliography with BibTeX

- Allows you to maintain a bibliographic database and then extract the references relevant to things you cited in your paper

- The visual presentation of BibTeX-generated bibliographies is based on a style-sheets concept that allows you to create bibliographies following a wide range of established designs

- Mendeley, ReadCube, ArXiv, IEEEExplore and most online resources allow you to export citations directly into a BibTeX file (.bib)
• biblio.bib acts as a database of references, and only includes in the bibliography those references you cite in your paper

```latex
@article{nameofentry,  
  author = {John Backus},  
  title = {Symmetric Encryption},  
  journal = {Journal of Modalities},  
  volume = 46,  
  year = 1993,  
  number = 2,  
  pages = {44--57}
}
```

• Save the .bib file in the same working folder as your .tex file and insert the following commands at the end of your text:

```latex
\bibliographystyle{amsalpha}
\bibliography{tutorial.bib}
```

The Paper

• LATEX is built off of the idea of structure over formatting

Ex:\section{Introduction}

Layers of sectioning

section
subsection
subsubsection
paragraph
subparagraph

Referencing

References

\section{Results}\label{res}
...
As seen in Section \ref{res} ...

Footnotes

...telephony\footnote{Phony telephones}

Citations

Redundancy \cite{nameofentry}
For multiple citations:
...methodology \cite{nameofentry, nameofotherentry}

Typesetting Math

Main strength of LATEX: allows you to typeset any sort of equations.

\LaTeX{} math support

\[
\int_a^b \frac{d\theta}{1 + p^2} = \tan^{-1} b - \tan^{-1} a
\]

Using math mode

Inline math mode: $...$
\[
\int_1^\infty e^{-x} dx \sum_{n=0}^{\infty} n!
\]

Display math mode: $$...$$
Numbered equations: \begin{equation}...\end{equation}
Some Commands

\begin{align*}
\pi_0 &= f(0)\pi_0 + f(0)\pi_1 \\
\pi_1 &= f(1)\pi_0 + f(1)\pi_1 + f(0)\pi_2 \\
\pi_2 &= f(2)\pi_0 + f(2)\pi_1 + f(1)\pi_2 + f(0)\pi_3 \\
\pi_3 &= f(3)\pi_0 + f(3)\pi_1 + f(2)\pi_2 + f(1)\pi_3 + f(0)\pi_4 \\
&\vdots \\
\pi_i &= f(i)\pi_0 + \sum_{k=1}^{i+1} f(i-k+1)\pi_k \\
\end{align*}

The \texttt{pmatrix}, \texttt{bmatrix}, \texttt{Bmatrix}, \texttt{vmatrix} and \texttt{Vmatrix} have (respectively) \((\cdot),\{\cdot\},\|\cdot\|,\text{and}||\cdot||\) delimiters built in.

\begin{align*}
\log \mu_{ijkl} &= \gamma + \gamma_i^W + \gamma_j^X + \gamma_k^Y + \gamma_l^Z + \gamma_{ij}^{WX} + \gamma_{ik}^{WY} + \gamma_{il}^{WZ} + \gamma_{jk}^{XY} + \gamma_{jl}^{XZ} + \gamma_{kl}^{YZ} + \gamma_{ijk}^{WXY} + \gamma_{ijl}^{WXZ} + \gamma_{ikl}^{WYZ} + \gamma_{jkl}^{XYZ} + \gamma_{ijkl}^{WXYZ} (5)
\end{align*}
Figures and Tables

• Both are floating environments:

\begin{figure}
\centering
\includegraphics[height=3in]{figure0.png}
\caption{The data.}
\end{figure}

\begin{figure}
\centering
\includegraphics[width=\textwidth]{figure1.png}
\caption{The data.}
\end{figure}

Formatting Tables

• The \textbf{table} environment defines the table style. The \textbf{tabular} environment defines the table itself.

\begin{table}[ht]
\centering
\begin{tabular}{|r||c|c|}
\hline
Trial & $n$ & $t$ \\
\hline
1 & 23 & 2 \\
2 & 15 & 10 \\
3 & 100 & 20 \\
\hline
\end{tabular}
\caption{The data.}
\end{table}

Captions and Labels

Captioning

\begin{tabular}
\caption{The data.}
\end{table}

Labeling

\caption{The data.}
\label{nameoftable}
\end{table}

Referencing

...in Table \ref{nameoftable}
What is Beamer?

- A LaTeX package defining a documentclass for slides
- Compiles with pdflatex to get a PDF file
- Basic unit is frame, which can run on multiple slides ... with the help of overlay
- Supports bibliographies, appendices and transitions
- Has many themes to choose from
- Supports transparency effects, animation commands, and other fancy goodies

Working with Beamer

- Beamer allows all the same commands as a normal LaTeX document, plus some.
  - Portability of your codes, e.g., from articles to presentations

Adding a Slide

```latex
\begin{frame} {Title}
...
\end{frame}
```

Special slides

- Title slide:
  - `\titlepage`
- Table of contents:
  - `\tableofcontents[currentsection]`

Some Special Environments

**Blocks**

```latex
\begin{block}
...
\end{block}
```

**Columns**

```latex
\begin{columns}
\column{0.5\textwidth}
  Column 1
\column{0.5\textwidth}
  Column 2
\end{columns}
```
Animation

- You can do basic animation in beamer with overlay
- `\pause` puts a pause before revealing the rest of the slides
- `command<1->j>` makes the command apply from frame #1 to frame #j

```latex
\begin{frame}
  \frametitle{A short introduction}
  \begin{itemize}
    \item shown entering this frame
    \item <2-> start showing on the next screen
    \item <3,5> ... and some but not others
  \end{itemize}
  \pause
  Then show this
  \uncover<5->{for this}
\end{frame}
```

Themes

- You can choose different themes for beamer.

```latex
\usetheme{theme}
\Antibes, Berkeley, Berlin, Goettingen, Malmoe, Szeged, Warsaw...
\usecolortheme{theme}
\beaver, crane, lily, rose, seahorse, whale...
```

Graphics with LaTeX

- The easy way: Import .jpg, .png, .pdf or .eps figures
  ```latex
  \begin{figure}
    \includegraphics[width=0.9\textwidth]{filename}
    \caption{This is a figure of something}
    \label{ImportantFigure}
  \end{figure}
  ```
- The hard way: Draw using pgf/tikz
  ```latex
  \begin{tikzpicture}
    \draw ....
  \end{tikzpicture}
  ```

The Easy Way

- Make your figures using your favorite software: Matlab, MS Visio, Adobe Illustrator, Omnigraffle, etc.
- Insert latex equations with softwares/plugins
- Export to pdf
- Import to your LaTeX document
- Pros: Easy (quick)
- Cons: Not native LaTeX, heterogeneity (e.g., font, style)
The “Hard” Way

• Draw your figures via “coding” inside your LaTeX document

\begin{tikzpicture}[scale=2.3]
\tickGrid[style=tickStyle,\]
\draw[->,>=latex,thick,\]
\end{tikzpicture}

\begin{itemize}
\item Pros: Vector graphics, seamless LaTeX integration, Gnuplot support, Matlab/Inkscape export, adapted to scientific plots
\item Cons: initial learning process may be long
\end{itemize}

The IEEEtran Class

• Typesetting papers suitable for submission to the Institute of Electrical and Electronics Engineers (IEEE).

• Conference, journal and technical note (correspondence) papers

• Providing a toolbox with useful commands for typesetting math such as \IEEEeqnarray

• A nice tutorial by Michael Shell, and a note by Stefan M. Moser

• Conferences and journals usually provide a template

\usepackage{amsmath}

Typesetting Equations

• The basic math package for LaTeX is amsmath
  - Environments such as equation, align, multiline, eqnarray, …

• The package IEEEtranTools provides good alternatives to many amsmath commands, in particular, based on IEEEeqnarray
  - It is possible to rely on IEEEeqnarray exclusively in all situations *

* S.M. Moser, “How to Typeset Equations in LaTeX ”

\caption{Comparison of the SDoF under different CSIT assumptions for $m \geq \max(n_A, n_B)$}
\begin{tabular}{|c|c|c|}
\hline
CSIT & $\max(n_A, n_B) \leq m < n_A + n_B$ & $m \geq n_A + n_B$ \\
\hline
perfect & $n_A$ & $n_B$ \\
\hline
delayed & $n_A - n_B$ & $n_A - n_B$ \\
\hline
delayed partial & $(n_A - n_B)^2$ & $(n_A - n_B)^2$ \\
\hline
no & & \\
\hline
\end{tabular}

Fig. 1. SDoF with $n_A = 3$ and $n_B = 2$ with perfect, delayed, and no CSIT.
Don’t Use Eqnarray

\begin{eqnarray}
   a & = & b + c \\
   & = & d + e + f + g + h + i + j + k + l \\
   & = & p + q + r + s \\
\end{eqnarray}

\begin{IEEEeqnarray}{rCl}
   a & = & b + c \\
   & = & d + e + f + g + h + i + j + k + l \\
   & = & p + q + r + s \\
\end{IEEEeqnarray}

\begin{multline}
   a + b + c + d + e + f + g + h + i + j + k + l + m + n + o + p + q \\
\end{multline}

Multiple Lines

\begin{IEEEeqnarray}{rCl}
   a + b + c + d + e + f + g + h + i + j + k + l + m + n + o + p + q \\
\end{IEEEeqnarray}

Equation Number

\begin{equation}
   a = \sum_{k=1}^{n} \sum_{\ell=1}^{n} \sin(2\pi b_k c_\ell d_k e_\ell f_k g_\ell h) \\
\end{equation}

\begin{IEEEeqnarray}{c}
   a = \sum_{k=1}^{n} \sum_{\ell=1}^{n} \sin(2\pi b_k c_\ell d_k e_\ell f_k g_\ell h) \\
   \IEEEyesnumber \\
\end{IEEEeqnarray}

Sub Equation Numbers

\begin{IEEEeqnarray}{rCl}
   a = & b_{16} & (60c) \\
   & = & b_{17} & (60d) \\
   & = & b_{18} & (61a) \\
   & = & b_{19} & (61b) \\
   & = & b_{20} & (62) \\
   & = & b_{21} & (63) \\
   & = & b_{22} & (64) \\
\end{IEEEeqnarray}
Conclusions

- LaTeX allows you to worry about the content and the structure, rather than the presentation.
- LaTeX has one of the most advanced math typesetting systems around.
- LaTeX is incredibly extendible.
- LaTeX keeps track of references so you don’t have to.
- LaTeX allows you to make more consistent, and more easily changeable, documents.

References

- THE comprehensive TEX archive: http://www.ctan.org/
- The Not So Short Introduction to LATEX2ε
- The LaTeX cheat sheet at http://www.strout.org/~winston/latex/
- The AMS-LaTeX reference card at http://math.brown.edu/~js/ReferenceCards/LaTeXRefCard.v2.0.pdf
- StackExchange: http://tex.stackexchange.com
- The IEEEtran package: http://www.michaelshell.org/tex/ieeetrans/
- How to Typeset Equations in LaTeX http://moser.isi.ee.cls/docs/typeset-equations.pdf
- Graphics with the tkz packages: http://altermundus.fr
- Google is your best friend