Introduction to LaTeX

A Method for Scientific Writing

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[1] This workshop was developed together with G. Clendenning and K. Mills

Introduction

Why should you use LaTeX?

A Comparison of Environmental Modelling Approaches on the Case-study of the Chalk River Laboratories Site

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***Abstract*— Robust and speedy assessment of radiological impact on non-human biota is crucial for the nuclear industry and the public. In order to show regulatory compliance, accurate dosimetric data must be calculated from the concentration of radionuclides in water measured at sites in question. This work compares frequently used environmental modelling techniques for dose estimation in aquatic biota on the practical case-study of the Chalk River Laboratories (CRL) site. Water concentration data from the Annual Environmental Monitoring Report were processed with the RESRAD-BIOTA and ERICA software, applied to two aquatic environments at CRL. Additionally, the absorbed dose is estimated with an analytic calculation combining the point-source-dose-distribution model and rescaled absorbed fractions for the appropriate geometries. A detailed MCNP dosimetry model of the studied biota is used to assess error. Deviations between the applied methods are observable at the derived tissue and soil concentrations, which become increasingly prominent in dose calculations. Furthermore, comparative analysis reveals deficiencies and strengths in the investigated tools, mostly overestimating the absorbed dose because of intrinsic constraints and therefore showing the need for adaptation and further analysis in order to ensure their reliability.**

I. Introduction

A. Absorbed Dose to Biota

Dose-based standards are in place to ensure environmental radiological protection, in Canada 10 mGy/d are the standard for aquatic animals. In order to show regulatory compliance, accurate dosimetric data must be calculated from the concentration values sampled usually only for water at the sites in question. Starting from a typical environmental report a reliability assessment of some methods for this task will be performed.

Assessing the impact of radiation on the natural environ-

In addition to that, calculating the absorbed dose from the available radionuclide concentrations requires knowledge of the organism-specific dose conversion coefficients (DCCs), defined as an absorbed dose rate per source activity. DCCs have been calculated by Monte-Carlo Methods for a set of Reference Animals and Plants of the FASSET project [5]. The internal and external dose rates for discrete energies are defined in terms of DCCs over the absorbed fractions in Eq. 2.

$$D_{int} = C_{int} \cdot \sum_{\nu} \sum_{i} E_i Y_i \Phi_\nu(E_i) = C_{int} \cdot DCC \tag{1}$$

$$D_{ext} = C_{ext} \cdot \sum_{\nu} \sum_{i} E_i Y_i (1 - \Phi_\nu(E_i)) = C_{ext} \cdot DCC \tag{2}$$

where Φ_ν is the absorbed fraction and of the radiation type ν and E_i and Y_i are energy and yield of the radiations per decay of the radionuclide. It has to be noted that the equation for external exposure holds only if the body and the surrounding medium are of the same density and composition.

For any radionuclide full absorption represents the upper bound for the internal DCC with E the energy of the source averaged over the emission spectrum.

$$DCC_\infty \approx 5.76 \cdot 10^{-4} E \tag{3}$$

Numerous screening tools like RESRAD-BIOTA, ERICA, EPIC, DosDimEco to name just a few are in place. Using analytical equations in combination with computed dose conversion coefficients (DCCs) [ref] they are a quick and

Introduction

Common Problems in Typesetting Documents with Word or LibreOffice

- Poor typographic control (kerning and leading, missing ligatures).
- Image embedding (instead of external links) and limited image editing options.
- Unexpected surprises when using external text.
- Unprofessional look.

Introduction

What is LaTeX?

TeX is a low-level markup and programming language created by Donald Knuth to typeset documents attractively and consistently.

LaTeX is a macro package based on TeXcreated by Leslie Lamport. Its purpose is to simplify TeX typesetting. Many later authors have contributed extensions, called packages or styles.

Introduction

Why LaTeX?

- LaTeX is the standard for mathematical typesetting
- LaTeX is turning into the standard everywhere else and especially on the web (google docs, wordpress...)
- LaTeX is free

Introduction

Why LaTeX for Me?

- Separation of editing and processing
- Emphasis on content
- Very good pdf support
- Easy typesetting for scientific requirements
- Good handling of citations

AND...it looks pretty

Introduction

When LaTeX for Me?

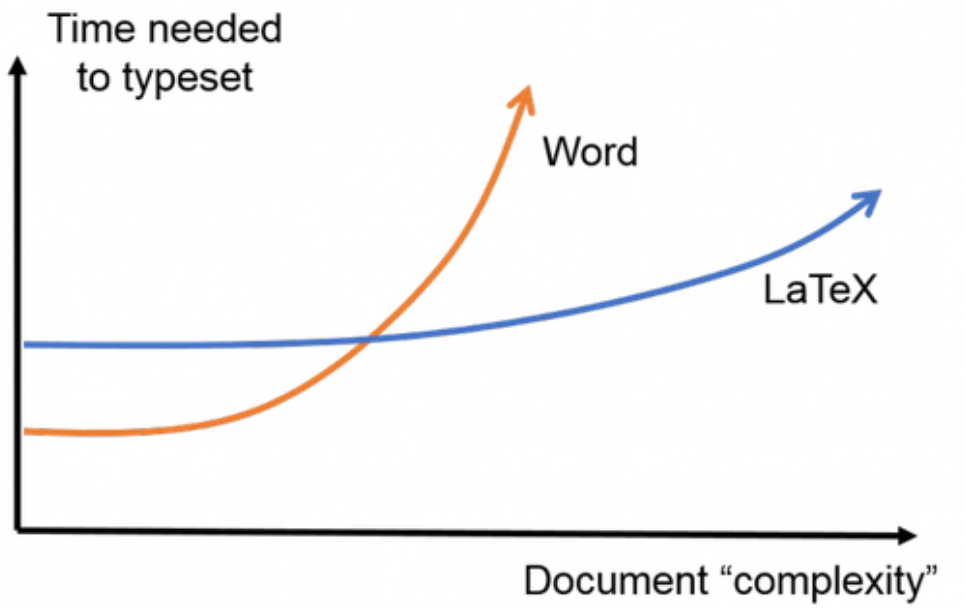


Figure : Time versus complexity when writing scientific documents. [2]

[2] Jose Louis Blanco, Word or LaTeX typesetting: which one is more productive? Finally, scientifically assessed. http://mappingignorance.org/2015/04/06/word-or-latex-typesetting-which-one-is-more-productive-finally-scientifically-assessed/

Advanced Topics

5 Reasons to use LaTeX in a scientific/university environment.

1. Modular documents (Regain the control over your thesis)
2. Version control (Collaboration with any version control software)
3. Controlling external graphs/pictures (Always have the most up to date graph)
4. Integrate with your bibliography software
5. Special documents (Presentations, poster, cv and cover letter, teaching documents)

Distributions and Editors

Requirements

System: The combination of the language and the macros.

Engine: An engine is an executable that can turn your source code to a printable output format. (pdflatex, latex)

Distribution: The collection of packages and programs that enable you to typeset without having to manually fetch files and configure things.

On distributions:

$\Rightarrow$ Distributions are an easy way to install what you need to use the engines and the systems you want.

Distributions and Editors

Distributions

- **TeXLive:** A cross-platform TeX distribution
- **MacTeX:** A TeXLive based distribution for Mac
- **MiKTeX:** A TeX distribution for Windows

Distributions and Editors

Editors

- **Cross-Platform:** TeXstudio, TeXmaker, gedit (latex-plugin), TeXworks, Lyx (WYSIWYG), (Vim, emacs)
- **Windows:** TeXnicCenter, WinShell
- **Linux:** Kile, LaTeXila, Gummi (WYSIWYG)
- **Mac:** TeXShop, TeXnicle
- **Web-based:** LaTeXLab, MonkeyTeX, ShareLaTeX

Basics

Getting Started

Hands on practice:

1. Start a document
2. Format text
3. Environments (comments, commands...)
4. Common elements (math, chemistry, lists)
5. Floats (pictures and tables)
6. Structuring a document
7. Citing
8. Advanced topics

Basics

Getting Started

```
\documentclass[a4paper]{article}

%my first hello world document

\begin{document}

hello world!

\end{document}
```

Basic Layout

Working with Text

- tiny: `\tiny{text}`
- footnotesize: `\footnotesize{text}`
- small: `\small{text}`
- Large: `\Large{text}`
- Huge: `\Huge{text}`
- *Italic:* `\textit{tetx}`
- **Bold:** `\textbf{text}`
- Small Caps: `\textsc{text}`
- Underline: `\underline{text}`
- Color: `\textcolor{color}{text}`
- Sans serif: `\textsf{text}`

Environments, Commands, Comments

Environments:

```
\begin{environmentname} text influenced \end{environmentname}
```

Commands:

```
\command_name[option1,option2,...]{argument1}{argument2}
```

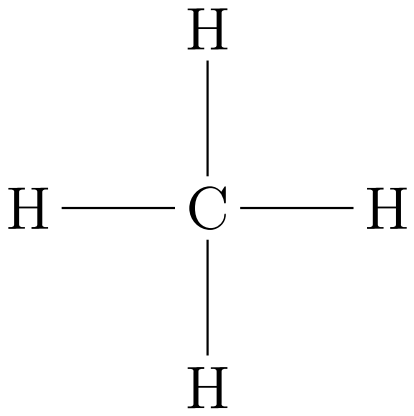
Comments:

```
% this is a comment
```

Groups:

```
 { \command Inside the group.} Outside the group.
```

Common Elements



7C0	hexadecimal
3700	octal
11111000000	binary
1984	decimal

$$CO_2 + C \longrightarrow 2\,CO$$

$$\exp(x) = \sum_{n=0}^{\infty} \frac{x^n}{n!} = \lim_{n\to\infty} \left(1 + \frac{x}{n}\right)^n$$

1. first item
2. second item

Lists

Sorted and Unsorted

sorted lists: `\begin{enumerate} \item[] \end{enumerate}`

1. first item
2. second item

unsorted lists: `\begin{itemize} \item[] \end{itemize}`

- first item
- second item

Mathematical Symbols

Symbols and Equations

```
\usepackage{amsmath}
```

- Math environment:
  `\begin{equation}...equation...\end{equation}`
- Inline math environment: `$...equation...$`

```
\frac{\alpha^2}{\beta^2}
```

$$\frac{\alpha^2}{\beta^2}$$

Manage correct spacing for units `\usepackage{siunitx}` is used with `\SI{'number'}{'unit'}`

Constitutional Formulas and Equations

```
\usepackage[version=3]{mhchem}
```

Chemical Equations: `\ce{...equation...}`

`\ce{CO2+C- >2CO2}` $\ce{CO2+C- >2CO2}$

Also...

`\usepackage{chemfig}` for chemical graphics:
`\chemfig{<atom1><bond type>[parameters]<atom2>}}`

Floats

Concept and Problem-Solving

Floats are containers for things in a document that cannot be broken over a page → they float (graphs, tables)

Hint:

If many floats occur in rapid succession, LaTeX stacks them all up and prints them together or leaves them to the end in protest.

Managing Floats:

- Placement specifiers `\begin{float}[h!,t,b]`
- `\usepackage{float}` provides the placement specifier `[H]`
- `\usepackage{placeins}` use with `\FloatBarrier`

Floats

Graphics: Import and Placement

- `\usepackage{graphicx}`
  `\graphicspath{{'path'}}`
- Insert files in text: `\includegraphics*[parameters]{mypicture}`
- Introducing graphics in float environment:
  `\begin{figure}...graphics...\end{figure}`

Hint:

You should always prefer vector graphics if possible (EPS, PDF).

Floats

Including Pictures

```
\begin{figure}[htb]
\centering
\includegraphics[width=0.8\textwidth]{image.png}
\caption{Awesome Image}
\label{fig:awesome_image}
\end{figure}
```

Floats

Formatting Tables

- Tabular environment:
  `\begin{tabular}[pos]{table spec}...\end{tabular}`
- Introducing tables in float environment:
  `\begin{table}...tabular...\end{table}`

```
\begin{tabular}{ l | c | r }
   1 & 2 & 3 \\ \hline
   4 & 5 & 6 \\ \hline
\end\{tabular\}}
```

1	2	3
4	5	6

Also...

For more control over tables: `\usepackage{tabularx}`, `\usepackage{booktabs}`, `\usepackage{tabu}`

Building a document

Main Body and Table of Contents

```
\begin{document}

\tableofcontents

\section{Title of the First Section}
... text ...
\subsection{Title of the First Subsection}
... text ...
\subsubsection{Title of the First Subsubsection}
... text ...
\subsubsection*{Title of the Second Subsubsection}
\addcontentsline{toc}{subsubsection}{Something Else}

\end{document}
```

Contents

1 Title of the First Section **1**
1.1 Title of the First Subsection 1
1.1.1 Title of the First Subsubsection 1
Something Else 1

1 Title of the First Section

... text ...

1.1 Title of the First Subsection

... text ...

1.1.1 Title of the First Subsubsection

... text ...

Title of the Second Subsubsection

Citing Literature

BibTeX

BibTeX provides for the storage of all references in an external, flat-file database.

- **Environment:** `\bibliography{bibfile}`
- **Two options:**
  - Type every entry manually
  - Use a database that produces BibTeX code (strongly recommended!)

Literature Databases

- JabRef
- EndNote (does not import BibTeX)
- Citavi
- Mendeley
- CiteULike
- RefWorks (web based)

Check out also http://en.wikipedia.org/wiki/Comparison_of_reference_management_software for the complete list.

Hint:

Google scholar and most paper-search websites (like SciVerse) can export BibTeX entries.

Citing

Basics and Styles

```
\bibliographystyle{style}
\bibliography{mybibliography1,mybibliography2}
```

Various styles available: plain, abstract, named ...

Standard LaTeX bibliography: numeric style of citations

For alternative options (journal or research specific) use the package:
`\usepackage[options]{natbib}`

Citing

BibTeX Entries

```
\cite{citation_keyl}
\cite{citation01,citation02,citation03}
```

BibTeX entry:

```
@article{greenwade93,
    author  = "George D. Greenwade",
    title   = "The {C}omprehensive {T}ex {A}rchive
    {N}etwork ({CTAN})",
    year    = "1993",
    journal = "TUGBoat",
    volume  = "14",
    number  = "3",
    pages   = "342--351"
}
```

Troubleshooting

What to do if it just doesn't work

1. Compile often
2. Check the log file for a detailed error message or line number
3. Check for missing or surplus brackets
4. Check for problems in closing an environment
5. Delete all temporary files and compile again
6. Copy and paste the error message in your browser
7. For MikTEX related issues: Don't start installing packages manually unless you are sure you know what you are doing!

Advanced Topics

What now?

Now the interesting part begins! 5 reasons to use LaTeX in a scientific environment.

- Special documents
  - Presentation
  - Poster
  - CV and cover letter
  - Teaching stuff
- Modular documents
- Version control
- Controlling external graphs
- Creating graphics

Modular Documents

Introducing Order

Very useful strategy for long LaTeX documents: split in several files.

Best practice:

- main document (main.tex)
- style document (style.sty)
- latex files folder
- pictures folder

include documents with `\include{filename}`

Hint:

To compile the child documents separate from the mother document use `\usepackage{subfiles}`.

Special Documents

Presentation

`\documentclass{beamer}`

LaTeX provides various themes along with colors:
`\usetheme{'theme'}` and `\usecolortheme{'theme'}`

Additional to the traditional sections hierarchy, beamer class comes with "frames" corresponding to the individual slides.
`\begin{frame}...text...\end{frame}`

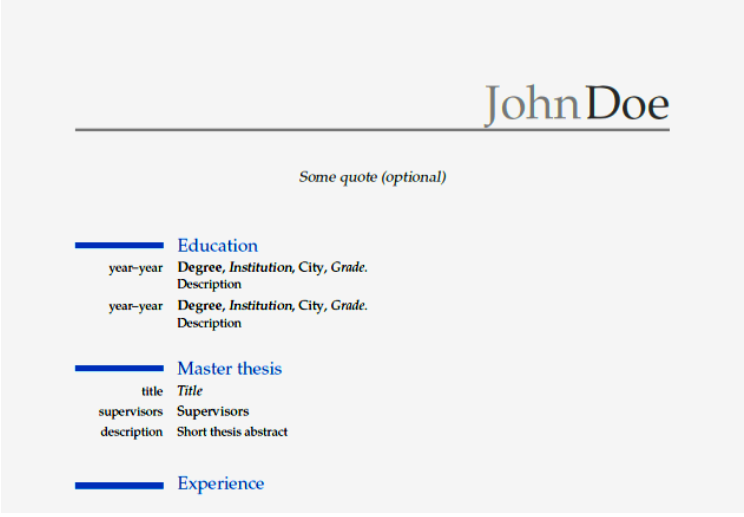
Hint:

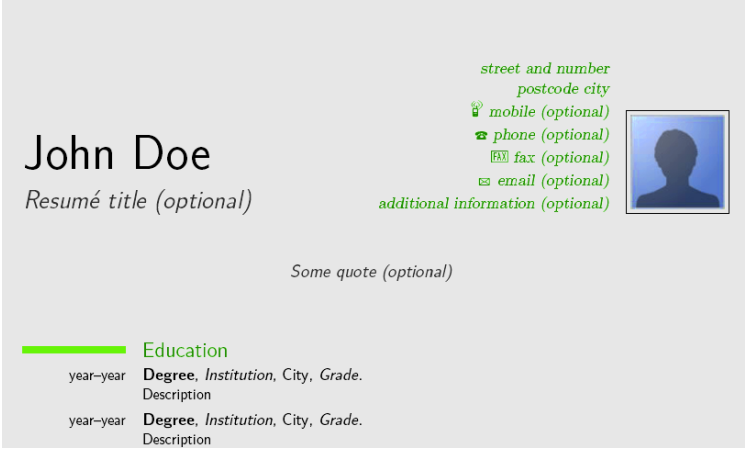
At http://deic.uab.es/~iblanes/beamer_gallery/index.html all available basic themes can be looked up.

Special Documents

Curriculum Vitae

```
\documentclass[options]{moderncv}
\moderncvstyle{"style"}
\moderncvcolor{"color"}
```





More Options

... for more convenience!

- More Special Documents: letters, cover letters, exams, assignments
- Version control: backups, collaborative work, non-destructive editing
- External graphs typesetting: control gnuplot graphs
- Creating graphics: with the `tikz` package

Questions?

... and Answers

- The not so short introduction: http://tobi.oetiker.ch/lshort/lshort.pdf
- A great book: https://en.wikibooks.org/wiki/Latex
- Forum for any kind of problem and any kind of solution: http://tex.stackexchange.com/
- The TEX Archive Network http://www.ctan.org/
- The LATEX Community: http://www.latex-community.org/
- DeTEXify: http://detexify.kirelabs.org/classify.html