MASTER THESIS

Your thesis title

Fachgebiet Elektrische Anlagen und Netze

der Fakultät für Ingenieurwissenschaften

der Universität Duisburg-Essen (Campus Duisburg)

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Acknowledgments

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Abstract

This thesis template is based on the one from GitHub repository of Systems Security Research Group University Duisburg-Essen

Keywords— LaTeX

1   Introduction to LaTeX

LaTeX is a high-quality typesetting system; it includes features designed for the production of technical and scientific documentation. LaTeX is the de facto standard for the communication and publication of scientific documents [1].

At the very beginning of this template and short tutorial of using LaTeX, some basic commands are shown in the following section.

1.1   Basic commands and symbols

Insert quotation marks

In LaTeX, the quotation marks are not recognized as in Microsoft Word or some other text-editing environment. If you type twice `"`, the output will be ”some quotation”. Hence, one should use `` `` `` combined with `"` or `''` in LaTeX environment instead and the output will be "some quotation". You can also check this in the source code. It is suggested to use `''` instead of `"`, because the second one is also used in LaTeX to type the German Umlautbuchstaben, which may cause errors when compile the file.

If you would like to write your thesis in German, you may use `,,` combined with `` `` `` to get „some quotation".

Insert space symbol

In LaTeX, the "space" used in your code will be shown as expected in most cases, however it will not be shown as a space in the generated pdf-file if typed after a LaTeX command. To add a space character in such cases, one should try to insert a `~` symbol to generate an extra space character in the text. For example, LaTeX is a typesetting system, instead of LaTeXis a typesetting system.

Type special characters

There are some characters defined as special characters in LaTeX, e.g. %. To type such characters in the text, try to add a backslash before them (\% instead of %).

Keep numbers and units in the same line

Sometimes it is necessary to add some number with units in the text, however the numbers and their units should not be divided into two different lines, hence try to use {\,} instead of "space" character in this case. You can check the source code in the corresponding tex-file.

For example, you may write:

In 2017, the electricity generated by PV was roughly 38.4 TWh, while wind about 104 TWh [2].

However, it maybe better to write the sentence as:

In 2017, the electricity generated by PV was roughly 38.4 TWh, while wind about 104 TWh .

Font settings

All font types and sizes are already defined in the cls-file, if you want to change the font types, formats or sizes you can check and change the corresponding lines of code (search for keyword "font").

You can get a list of LaTeXsupported fonts here. To make sure this template can work on different operating systems, in the document class file only the font types directly accessible with LaTeX packages are used. Of course it is possible to use other fonts, e.g. Times New Roman or Tahoma on Windows platform.

Define and use colors

LaTeX offers numerous predefined colors, however in certain cases it is still necessary to define new customized colors. To do so, one can use the \definecolor command

in LaTeX, where the first parameter is name of the customized color, the second one is the model chose to define the color (xcolor offers gray, rgb, RGB, HTML and cmyk, you can check the corresponding definitions here) and the third one is description of the color. You can search online for color calculators or pickers to find the corresponding values for colors. The following code defines a new color so-called "new-color":

```
\definecolor{new-color}{RGB}{0, 170, 165}
```

You may use `{\color{color}text}` or `\textcolor{color}{text}` to change text color. To give an example, the customized color defined before is used. With the code `{\color{new-color}example}` it returns example.

You can also use ! character to use percentage colors or even mix different colors to get a new one (e.g. `red!50` is 50% red).

For example, colors of following numbers are fading from 100% to 10% of LaTeX predefined red 0123456789. This method is especially helpful to set colors for a table, which will be discussed in chapter 4.

It is also feasible to get a new color by mixing defined colors. For example one can mix 50% yellow with 90% red `{\color{yellow!60!red!90}mixed color}`, the output is mixed color.

2 Text Structure

In a chapter it usually has several levels of sections and subsections to keep the contents well organized.

2.1 This is a new section

2.1.1 This is a new subsection

Although in LaTeX, there is also a `\subsubsection` command which can generate an extra level of contents under subsection, it is not recommended to be used. The possible solution maybe:

A new paragraph

instead of

2.1.1.1   A new subsubsection

It should be noticed that all font types and spacing before or after the titles can be customized in the cls-file.

2.1.2 Make a list

It is also quite often to list out some important points in the text.

- This is an unimportant entry

- This is another unimportant entry :D

3 Using Mathematical Expressions

LaTeX offers powerful support for mathematical expressions, which are rather important in scientific documents. In this chapter, several examples to insert mathematical expressions are shown.

3.1 Equations and Formulas

Following are some equations from IEEE Standard 738-2012 [3], which are used here as example and to show some basic operation and LaTeX code to insert mathematical equations into your text.

If you want to insert a single equation (as the one shown in Formula 3.1), just create an **equation** environment and type the corresponding equation.

$$q_r = 17.8 {\cdot} D_0 {\cdot} \varepsilon {\cdot} \left[\left(\frac{T_{max}+273}{100} \right)^4 - \left(\frac{T_a+273}{100} \right)^4 \right] \qquad W/m \qquad (3.1)$$

Maybe you also want to explain meanings of the variables used in the equation, LaTeX offers a **tabbing** environment which can be used to align the variables and corresponding explanations. As an example, for the variables used in Formula 3.1, one may write:

where D_0 is the conductor diameter,

             ε is the emissivity of surface area,

             T_{max} is the maximum operating temperature of the conductor,

             T_a is the ambient temperature.

As shown above, to refer one variable or insert some mathematical expression in the text body, one may use `{$ $}` to create a mathematical expression environment.

It is also useful to write some equations in one block (as shown in Formula 3.3), however to make the equations look better, you may align the equations with each other. For example in the exemplary equations, they are aligned to the equal symbol. To align text in LATEX environment, the & symbol is used.

$$q_c{+}q_r = q_s + I^2{\cdot}R\,(T_s) \tag{3.2}$$

$$I = \sqrt{\frac{q_c{+}q_r{-}q_s}{R\,(T_{max})}} \tag{3.3}$$

Similar to the \aligh environment, you may create equations with \subequations environment, which will create 3.4a and 3.4b instead of a new number for the second equation as in Formula 3.3 did.

$$q_{c1} = K_{angle}{\cdot}\left[1.01{+}1.35{\cdot}N_{Re}{}^{0.52}\right]{\cdot}k_f{\cdot}(T_{max}{-}T_a) \qquad W/m \tag{3.4a}$$

$$q_{c2} = K_{angle}{\cdot}0.754{\cdot}N_{Re}{}^{0.6}{\cdot}k_f{\cdot}(T_{max}{-}T_a) \qquad W/m \tag{3.4b}$$

3.2   In-line Mathematical Expressions

It is usually necessary to use some mathematical expressions in-line, e.g. to mention variables or add units after numbers. As mentioned before, using {$ $} in-line environment is rather simple, e.g. H_2O (created with {$ H_20 $}). However, expressions generated with mathematical environment in LATEX are always italic. If you wish to have normal expressions, you may use the \ensuremath environment, e.g. H_2O (created with H{\ensuremath{_2}}O). If you need to insert some mathematical expression quite often, you can also define a new command for such symbols or expressions. For example, you may define a new command for superscript -n and the dot multiplication sign with

\newcommand{\inTextInv}[1]{\ensuremath{^{-#1}}}

\newcommand{\inTextDot}{\ensuremath{\cdot}}

So that you can use `m{\intextDot}s{\intextInv{1}}` to create the SI unit for speed m·s^{-1} and `kg{\intextDot}m{\intextDot}s{\intextInv{2}}` for the SI unit of force kg·m·s^{-2}.

4 Figure and Table

In a scientific document, it is necessary and essential to insert several figures or table to visualize the results.

4.1 Insert Images

LaTeX provides several options to handle images and make them look exactly what you need. In this section, some basic operations are explained, e.g. how to include images, how to shrink or enlarge them and how to reference them within your document.

The following code block shows a basic example to insert a figure into the text (see Figure 4.1). The explanations for each line of code are also written in the code block.

```latex
\begin{figure}[h!]
        % position the figure at the horizontal center
        \centering
        % figure width set to 0.8 times the width of text body
        \includegraphics[width=0.8\textwidth]{fig_1.pdf}
        % set figure caption
        \caption{An exemplary figure}
        % set label for this figure so it can be refered in the text
        \label{fig_1}
\end{figure}
```

In this template, all exemplary figures are generated by matplotlib.pyplot library and scaled to wished size in the text. It should be however noticed, that due to the resizing process in LaTeX, the font size set in original figures may be lost. Therefore, it is important to attempt different font size in your figures generated by software or programming languages. Another option is to utilize the tikzpicture package in LaTeX, which can help to add text description of axes. An example of using tikzpicture package to obtain the same figure as Figure 4.1 is shown in Figure 4.2. You can compare this two figures and refer to the corresponding codes when necessary.
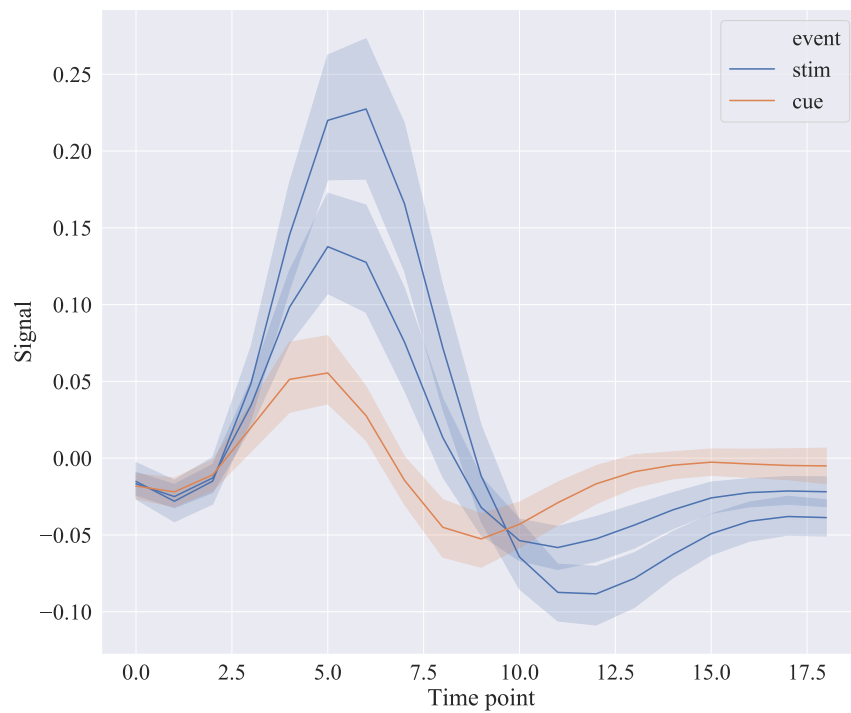
Figure 4.1: An exemplary figure

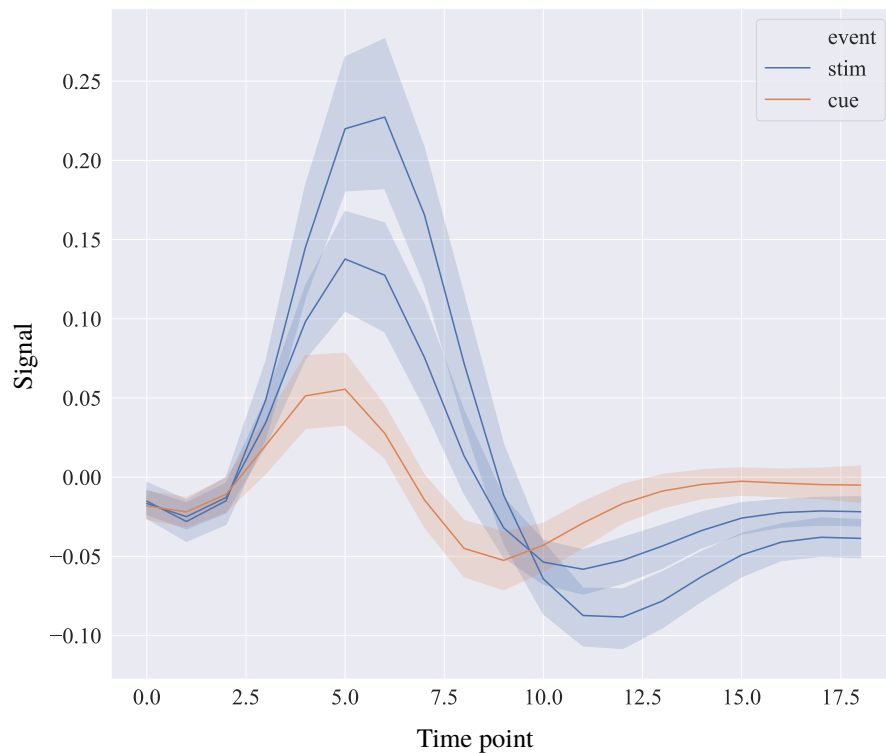Figure 4.2: An example of tikzpicture

Sometimes one need to insert multiple subplots at once. In LaTeX this can be realized by applying the `\subfloat` environment. In Figure 4.3, an example is shown, where four subfigures are included in one figure.

(a) Sub-1   (b) Sub-2

(c) Sub-3   (d) Sub-4
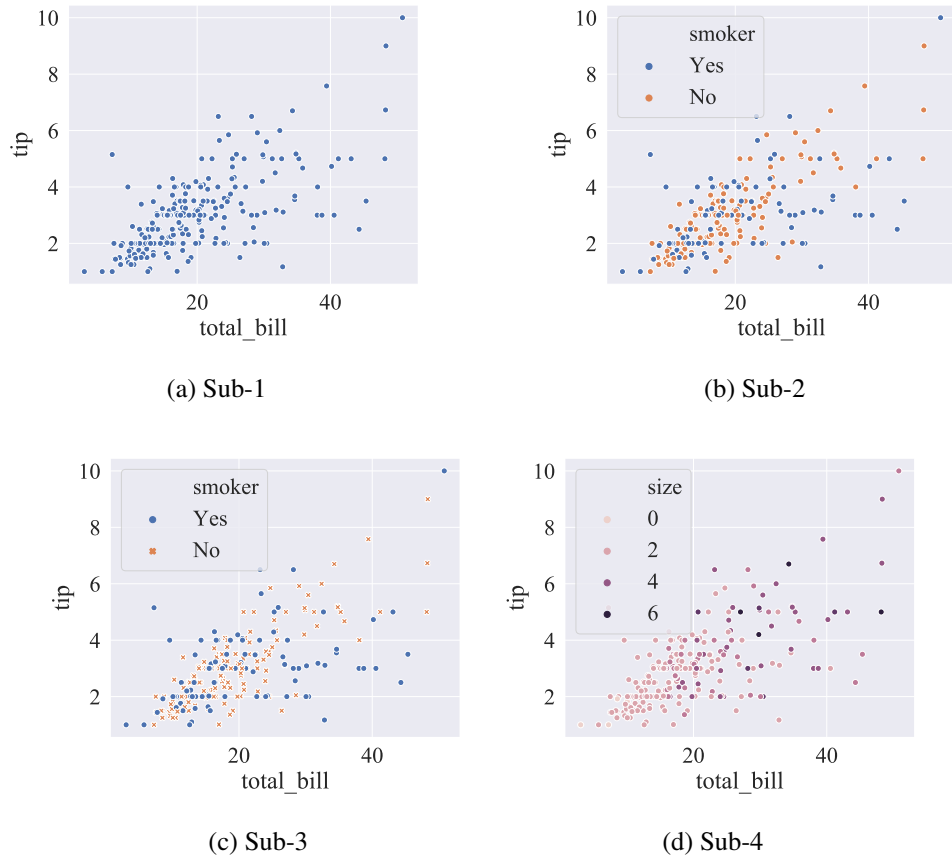
Figure 4.3: Example of subfigures

4.2 Inserting Tables

Table is another common element in scientific documents. LaTeX provides a large set of tools to customize tables. Some most common types and corresponding commands are shown in this section.

The following code block shows a simple example to create a table. The parameter of command `tabular` is aimed to set the number of columns, their delimiters and the alignment types. As shown in the exemplary codes, `| l | c | r |` creates a table with three columns and the "|" symbols create vertical delimiters in the table. The letters are the definitions of alignment for each column, e.g. "l" means left alignment, "c" center and "r" right. To add horizontal delimiters, just add `\hline` before or after the entry of a row.

```
1   \begin{table}
2       \centering
3       \begin{tabular}{| l | c | r |}
4           \hline
5           Points per game & Rebounds per game & Assists per game \\
            \hline
6           7.6  & 1.9 & 1.3 \\ \hline
7           15.4 & 3.1 & 2.5 \\ \hline
8           19.9 & 5.3 & 3.8 \\ \hline
9       \end{tabular}
10  \end{table}
```

Points per game	Rebounds per game	Assists per game
7.6	1.9	1.3
15.4	3.1	2.5
19.9	5.3	3.8

Table 4.1: An exemplary table

Now the parameter | l c r | is used to format columns and some \hline commands are removed, the output table is shown in Table 4.2.

Points per game	Rebounds per game	Assists per game
7.6	1.9	1.3
15.4	3.1	2.5
19.9	5.3	3.8

Table 4.2: Another exemplary table with fewer borders

It is sometimes necessary to merge several cells into one to make the table contents more evident. In LaTeX this function can be done by using \multicolumn{cols}{pos}{text} or \multirow{number of rows}{width}{text} commands. It should be noticed in Table 4.4, instead of using simply \hline, \cline{2-3} is used, which means add a horizontal border only from the 2nd to 3rd columns.

In chapter 1 the color function in LaTeX has already been introduced. The colors can be set as the background color with \rowcolor or \rowcolors commands. The first one is used to set color for a single row, while the second one can automatically alternate

Points per game	Rebounds per game	Assists per game
N/A		1.3
15.4	3.1	2.5
19.9	5.3	3.8

Table 4.3: Exemplary table with horizontally merged cells

Points per game	Rebounds per game	Assists per game
N/A	1.9	1.3
	3.1	2.5
19.9	5.3	3.8

Table 4.4: Exemplary table with vertically merged cells

the row color as shown in Figure 4.5, where the color is defined before and the title is set to 60% and the other rows alternates between 20% and 40%.

Points per game	Rebounds per game	Assists per game
7.6	1.9	1.3
15.4	3.1	2.5
19.9	5.3	3.8
22.5	6.3	4.9
25.2	5.5	5.5

Table 4.5: Exemplary table with two colors

Sometimes the description or content in a table cell is too long, with **tabular** environment the cell width will always fit the input text length (as shown in Table 4.6). To wrap the text inside a cell, you can use multiple methods, here in this template the environment or package **tabularx** is introduced, which original aims to make tables with fixed cell width.

To use **tabularx**, you should enter an option for the table width, so that the generated table will always have the width as you set. It has also an extra description X for column

format is defined, which can be used to divide the set width and make all columns with X-type the same width, you can refer to Table 4.7 and the corresponding source code.

Season	Minutes per game	Points per game	Rebounds per game	Assists per game
1996–97	15.5	7.6	1.9	1.3
1997–98	26.0	15.4	3.1	2.5
1998–99	37.9	19.9	5.3	3.8
1999–00	38.2	22.5	6.3	4.9
2001–02	38.3	25.2	5.5	5.5
2002–03	41.5	30.0	6.9	5.9

Table 4.6: Table width exceeds the text width

It should be noticed, the X-type in **tabularx** set the alignment to left side of the cells. To center the contents in these cells, one can define a new Y-type with the command `\newcolumntype{Y}{>{\centering\arraybackslash}X}`. Now set all X-type columns in Table 4.7 as Y-type, Table 4.8 can be obtained.

Season	Minutes per game	Points per game	Rebounds per game	Assists per game
1996–97	15.5	7.6	1.9	1.3
1997–98	26.0	15.4	3.1	2.5
1998–99	37.9	19.9	5.3	3.8
1999–00	38.2	22.5	6.3	4.9
2001–02	38.3	25.2	5.5	5.5
2002–03	41.5	30.0	6.9	5.9

Table 4.7: An exemplary tabularx

Season	Minutes per game	Points per game	Rebounds per game	Assists per game
1996–97	15.5	7.6	1.9	1.3
1997–98	26.0	15.4	3.1	2.5
1998–99	37.9	19.9	5.3	3.8
1999–00	38.2	22.5	6.3	4.9
2001–02	38.3	25.2	5.5	5.5
2002–03	41.5	30.0	6.9	5.9

Table 4.8: Center contents in a tabularx

5 Citation and Bibliography

There are a lot of literature management software in the market, e.g. EndNote, Citavi, Mandeley, etc. Taking Citavi as example, one can add literature and reference sources into this software and exported all references into a bib-file, which can be read by LaTeX and directly added as references in the generated pdf-file.

In this thesis template, the citation management package used is biblatex, hence in Citavi you should export the selected references by setting a BibLaTeX export filter. It should be noticed, the time format used in the package biblatex is the Coordinated Universal Time (UTC) time format, i.e. yyyy-MM-dd . Citavi also supports different time formats, e.g. German format dd.MM.yyyy . However, problems may occur when one attempted to export such time format into a bib-file. Therefore, it is recommended to use UTC time format in Citavi and then export.

Each reference entry has a unique BibTeX key within your Citavi project and in the bib-file, which can be directly referred in LaTeX environment with the command \cite. For example, type \cite{Burger.20180508}, the corresponding reference will be referred in the text [2].

6 Acronym and Glossary

It is rather handy to use acronyms or abbreviations in your thesis with LaTeX. As defined in the tex-file, the first entry of `\newacronym` command is the key you entered to call the acronym, while the second one is the short-form of this acronym and the third one is long-form.

For example, an entry of acronym is defined as:

`\newacronym{der}{DER}{Distributed Energy Resouce}`

To refer the full version of this term for the first time, you may use `\gls{der}` to get Distributed Energy Resource (DER) as output and `\acrfull{der}` gives the same result Distributed Energy Resource (DER) , while `\acrshort{der}` for the short form DER and `\acrlong{der}` for the long form Distributed Energy Resource .

If is quite useful to refer an acronym with the plural form and it is quite simple to realize in LaTeX— just add "pl" at the end of one command, e.g. `acrfullpl{der}`, and the output will be Distributed Energy Resources (DERs) .

Bibliography

[1] LaTeX3 Team. *LaTeX – A document preparation system*.
    URL: https://www.latex-project.org/ (Accessed on: 20 Apr. 2019).

[2] B. Burger. *Power generation in Germany – assessment of 2017*.
    Wikipedia, 2018-05-08.
    URL: https://www.ise.fraunhofer.de/content/dam/ise/en/
    documents/publications/studies/Stromerzeugung_2017_e.pdf
    (Accessed on: 23 Apr. 2019).

[3] *IEEE standard for calculating the current-temperature relationship of bare
    overhead conductors*. eng.
    New York: Institute of Electrical and Electronics Engineers, 2013. 58 pp.
    ISBN: 9780738188881.
    URL: http://ieeexplore.ieee.org/servlet/opac?punumber=6692856.