UNIVERSITY OF TWENTE.

Faculty of Electrical Engineering, Mathematics & Computer Science

The greatest thing since bread came sliced

Homer J. Simpson

B.Sc./M.Sc. Thesis *or* Individual research assignment

Month 201X

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Preface [optional]

The preface is optional. It contains anything that is outside the actual scope of the report, for instance

- how you ended up doing the assignment that is reported in this document;
- your personal opinion on the subject;
- an acknowledgment to the people that helped you carrying out the work.

Alternatively an epilogue or acknowledgment chapter could be included in the back-matter of the report.

Summary

The summary consists of one or two pages, and covers all chapters of the report except the appendices. In other words: it should at least summarize the background/motivation of the work, the goal or research question, the approach, the results, and the main conclusions and recommendations. Divide the summary in paragraphs that roughly correspond to the chapters in the main body of your report. You do not need to explicitly mention the different chapters though.

Introduce acronyms in your summary *only* if you use them later in the summary. Do not use the `\ac` command in the summary; also see Section 2.4.

It is not very common to cite references in the summary. It is possible though, particularly if the presented work really builds up on one or more particular papers/reports.

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List of acronyms

FCC Federal Communications Commission

IEEE Institute of Electrical and Electronics Engineers

OBFN optical beamforming network

UWB ultra-wideband

(Also see Section 2.4.)

Chapter 1

Introduction

Below you find an example of an introduction structure. See [1], [2] for more extensive hints on writing.

1.1 Motivation

What is the relevance of the presented work, and what is the relation to previous work done in this field?

1.2 Framework

Where was the presented research carried out, and to what project(s) is it related?

Possibly this section is combined with the first section, particularly if the presented work is directly motivated by previous work done in the same group.

1.3 Goal(s) of the assignment/Research question(s)

What is aimed to be achieved by this work? Or: what is the particular question that is answered by this report?

This section should be short and very specific.

Possibly several distinct research questions are formuled as a numbered list, but: the smaller the number of questions, the better.

1.4 Report organization

This section describes the structure of the report. It consists of one paragraph, listing the *purposes* of the individual chapters (and nothing else), for instance:

The remainder of this report is organized as follows. In Chapter 2, blabla .... Then, in Chapter YY, ... Finally, in Chapter 3, conclusions and recommendations are given.

Note that appendices are not described here, and that the word 'Chapter' is capitalized when it is followed by a number.

The chosen structure should either be a common one, or follow from the foregoing sections in an obvious way. If necessary, one might consider adding one more section between the goal and report organization, describing the rough approach.

1.5 Technical level of the introduction

The introduction chapter should not be too technical, i.e. equations, graphs, and technical drawings should preferably be postponed to later chapters, unless they directly form the core motivation of the work. The technical level of the introduction should be such that the relevance, goal, and logic of the report structure are clear. Possibly refer to later chapters for technical details, in order to reassure the reader.

Chapter 2

Body of the thesis

This chapter contains a few general hints on the writing. See [1], [2] for more details.

2.1 Structure

All chapters in between the introduction and the conclusions serve as a support for what is claimed in the conclusion. Several structures are possible, depending on the type of work. Discuss the structure of your report with your advisor before you start writing the chapters.

When a chapter consists of several sections, introduce the structure of the chapter in the initial section (which could be an unnumbered section). The particular purpose of the chapter should be introduced there as well (as is done above). In case of a comprehensive chapter, end it with a summary or conclusion.

2.2 Figures and tables

Use figures and/or tables only if this enhances the understanding of the reader. Refer to figures and tables using figure/table environments and labels, resulting in a combination of the chapter and figure/table number (for instance 'Figure 2.1'), and indicate their purpose; otherwise the figure/table might as well be left out.

A figure can for instance be a graph, picture, or schematic drawing. Make sure that all relevant aspects of a figure are well visible, when printed on A4 paper. Preferably use vector-oriented graphics, and minimize the use of colors, unless they can be clearly distinguished when printed to black and white.

Captions should be put below each figure, whereas they should be put *above* tables. The captions should only describe what is depicted by a figure/table ('Measured attenuation as a function of frequency for cable lengths of 1 m, 5 m, and 10 m'), and not what should be concluded from it ('The longest cable has the largest

Figure 2.1: Empty figure

attenuation for all frequencies.'). The latter should be put in the refering text. Always try to place the figure/table after the text in which it is refered, preferably at the top of bottom of a page, or in between paragraphs. Related figures can be combined in one figure environment using subfigures.

If a figure has been copied from a different source, clearly indicate that in the caption (and ask for permission, if required).

2.3 Equations

Very short equations such as $I = V/R$ can be created in-line using dollar symbols; otherwise an equation environment (or related environment such as multline or align) should be used. Equations should be numbered after their last line in order to enable referencing elsewhere in the text. Equations are part of the sentences and therefore usually end with a period or comma. For example, according to Ohm's law, the current I flowing through a resistor is given by

$$I = \frac{V}{R}\,, \tag{2.1}$$

where V is the applied voltage, and R is the resistance.

See [2] for some more guidelines or formating equations.

2.4 Acronyms

Acronyms should be introduced upon their first usage in the main body of the report. For instance once the Federal Communications Commission (FCC) has been introduced, it can be abbreviated to FCC.

Introducing, using and listing acronyms is facilitated using the `Acronym` package and `\ac` command.

A common misconception is that the constituting words should be capitalized when the corresponding acronym is in capitals, but this is only the case when the abbreviated words form a name, such as the Institute of Electrical and Electronics Engineers (IEEE). On the other hand, technical terms such as ultra-wideband (UWB) or optical beamforming network (OBFN) should not be capitalized, even though their acronyms (UWB OBFN) are.

Acronyms always have to be introduced in the main body of the report, even if they have already been introduced in the summary. Therefore it is better to use the `\ac` command only in the main body of the report, and not in the summary.

2.5 Citations

Use citations if the corresponding book, paper, or report supports a claim that you make in your text, or if it clarifies the context of the work (i.e. what related work have you or other people done). Only list references that are actually cited in the text; the bibliography is not just a list 'for further reading' (although that could be made separately), or a list of documents that you consulted during your work.

If you literally copy text fragments from a different source, explicitly indicate this using quotes and italic characters. Only copy or summarize material from different sources if this contributes to the understanding of the reader; in principle your report should be readable without consulting the references.

The credibility of the claims in your text is largely influenced by the quality of your cited references: for instance papers in international peer-reviewed journals are generally more reliable than Wikipedia articles.

Also, note that many readers will tend to judge your knowledge on the context of your work based on the references that you cite.

Some examples are given in the References chapter [1]–[7].

Chapter 3

Conclusions and recommendations

This chapter consists of two sections.

3.1 Conclusions

The conclusions should directly answer the research question that was formulated in Chapter 1, or state to what extent the research goal has been achieved. This is what distinguishes the conclusion from the summary: it should *not* summarize the *contents* of the preceding chapters, but rather only what should be *concluded* from them.

Dedicate one paragraph to each seperate conclusion.

3.2 Recommendations

The recommendations basically answer two questions:

1. How could the presentated research be improved if it were repeated?
2. What would be the appropriate question(s) for future research starting from what is presented here?

Dedicate one paragraph to each seperate recommendation, and clearly distinguish between the two types of recommendations.

Bibliography

[1] F. B. J. Leferink, “Guide for writing technical reports and papers,” Telecommunication Engineering Group, University of Twente, 2012.

[2] A. Meijerink, “Communication in engineering,” Telecommunication Engineering Group, University of Twente, May 2012.

[3] “Web site of the Telecommunication Engineering Group at the University of Twente.” [Online]. Available: http://www.utwente.nl/ewi/te/

[4] C. H. Cox, *Analog optical links*. Cambridge University Press, 2004.

[5] A. Meijerink, “Coherence multiplexing for optical communication systems,” Ph.D. dissertation, University of Twente, 2005.

[6] A. Meijerink, C. G. H. Roeloffzen, R. Meijerink, L. Zhuang, D. A. I. Marpaung, M. J. Bentum, M. Burla, J. Verpoorte, P. Jorna, A. Hulzinga, and W. van Etten, “Novel ring resonator-based integrated photonic beamformer for broadband phased array receive antennas—Part I: Design and performance analysis,” *IEEE/OSA Journal of Lightwave Technology*, vol. 28, no. 1, pp. 3–18, Jan. 2010.

[7] A. Meijerink, C. G. H. Roeloffzen, L. Zhuang, D. A. I. Marpaung, R. G. Heideman, A. Borreman, and W. van Etten, “Phased array antenna steering using a ring resonator-based optical beam forming network,” in *13th IEEE/CVT Symposium Benelux, Liège, Belgium*, 23 Nov. 2006, pp. 7–12.

Appendix A

Title of first appendix

Anything that does not directly contribute to the understanding for the reader, but is still relevant in order to support particular claims made in the report (for instance a purely mathematical derivation), should be put in the appendix. (That is, only if it cannot be found elsewhere. Otherwise a simple citation suffices.)

For the rest the appendices are like the other chapters, i.e. they can have sections, figures, tables, and citations (even though the appendix comes after the list of references).

A.1 First section