PhD Thesis Writing Hints

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1. Preliminary Steps

1.1. Discuss with Your Supervisor(s)

Have a chat with your supervisor about what their expectations are for your thesis and for suggestions on how to go about it.

1.2. Look Over Some Example Theses

Looking over some good examples of theses is a good way to get an overall picture of how they are written. As you glance through them, make a note of what things you like for use when writing your own thesis.

1.3. Talk to Other PhD Students

Having a talk to other PhD students who are either in the writing process, or have recently completed their writing can give you valuable hints about how to go about your thesis writing.

1.4. Assemble a Set of Your Publications and Key References

It is very useful to put together a collection of all your publications, reports along with key reference papers etc to refer to when writing your thesis.

2. Produce a Detailed Layout

2.1. Original Contribution

A suggested starting point in writing a thesis is to put together a short list (using dot points) of what you think are the major original contributions of your work in say a page or so. This can be largely based on your conclusions from your published papers. Try to write as clearly and concisely as possible. Discuss this with your supervisor. It is important to always keep these points clear in your mind as you go about planning and writing your thesis.

Remember that original contributions don't necessary need to mean that you invented a brilliant new concept which worked perfectly. An original contribution could include having a new idea, analysing it carefully and proving both in simulation and experiment that it doesn't work!

2.2. Thesis Contents

Produce a detailed chapter organization/layout of your thesis showing :

- chapter titles
- section titles
- subsection titles

In addition under each of the above you should put some dot points about what is going to be included in each part along with brief notes about key figures. Try to estimate how many pages each of the above parts will be. This helps in the checking that the chapters are balanced (see below).

When writing this keep the following in mind :

- *purpose* : it is important to remember that you are writing for two purposes. Firstly it is to convince the thesis examiner that you understand the background and significance of your work and that you have made significant original contributions to the state of the art in your

particular field. Secondly, it is for a reader who is interested in your work and wants to learn more about what you have done. In general you can assume that this reader is an electrical engineering graduate in your field.

- *focus* : remember that the focus of a thesis is the original contributions. It is important to identify these upfront so that as you write the thesis you keep in mind that your introduction, literature survey, background theory etc are all going towards explaining why your contributions are original and significant. Avoid getting sidetracked in your writing and spending many pages on material which though is interesting, does not contribute to understanding your original contributions. As you write material keep asking yourself questions such as : why is this being included? what important points do I want the reader to understand? how does this follow on from what has been covered earlier and how does it fit in with what is to come? This latter leads into the concept of "flow".
- *flow of ideas* : try to organize the order in which material is presented in a logical fashion, so that the ideas naturally "flow". A good organization will avoid unnecessary repetition of concepts and make it much easier for the reader to follow the train of logic.
- *conciseness and clarity* : try to write as clearly and succinctly as possible. Don't get into the mindset that the thesis needs to be really long and so you need to try to "pad it out". Avoid continual repetition of concepts. Work hard on getting good figures which clearly explain what you are trying to say. Keep your explanations simple and direct.
- *balance* : try to keep the lengths of the chapters roughly balanced in the number of pages. Of course the introduction and conclusions may be quite a bit shorter than the rest. The aim is to avoid having say chapter 3 being 100 pages long which chapter 4 is only 10 pages long.
- *examiners* : it is useful to try putting yourself in your thesis examiner's shoes. They are busy people. They receive a copy of your thesis in the mail and need to fit in reading it in while doing everything else they need to do. They need to judge whether or not you have made sufficient original contributions for a PhD. Their job is made easier if the thesis is well organized with a good introduction, a clear literature review, a main body which explains the original contributions and shows their significance, and conclusions which again summarise the contributions. The job is made more difficult if the thesis is poorly organized; hard to follow; contains excessive spelling, grammar or punctuation errors; contains lots of unnecessary material; is overly long; or does not clearly show that the contributions are original and/or significant.

A detailed thesis layout could end up being say five to twenty pages long. It is a "living" document, which means that as you write sections you can continually update it. It is also handy for making notes, for instance as you are writing one chapter you may want to modify the plan for some of the other chapters while it is fresh in your mind.

Once you have a detailed thesis contents you are then able to start writing anywhere in your thesis. It also means that if you start in one area, and get tired of writing in that part, you can work for a little while somewhere else in the thesis.

2.3. Where to Start Writing Your Thesis

One approach in writing a thesis is to start off with the sections (usually the later chapters) which relate to published papers as these generally require the least work as the figures and the ideas have already been largely put together. Note that it is not recommended that you simply copy the text from published papers however easy this may seem. It is a better practice to read what you have written and rewrite it again as this will make you more familiar with the material and result in a better flow for your entire thesis. Using this approach you would then go back and write the earlier chapters at the end, with now a good understanding of what these chapters need to contain.

Another approach is to start at the beginning of the thesis and work from there. In some ways this is more logical approach but does have some aspects which need caution :

- it may difficult to decide what content to include in these early chapters and hence result in unnecessary work
- it is often harder to write these chapters than the later chapters and this can be discouraging

2.4. Introduction

When writing the early chapters of a thesis, one area of difficulty is deciding what to include. It is important to keep in mind that these chapters should include only what is necessary to ensure that the reader can understand the theory, simulations, experimental results and appreciate the original contributions of the work. Remember that the introduction should not be overly long as it is only meant to set the scene for the later work. See some examples of theses to get a feel for this.

2.5. Literature Review

A thesis needs to emphasise your original contributions. To do this you need to explain what has been done before. A good principle for writing the literature review is to start with general ideas (the broad concept) and keep narrowing it until you get to the main issue to be addressed (the gap).

Generally some sort of literature survey is included in the first or second chapters of your thesis. This literature survey would normally give a bigger picture of the field and highlight why what you are doing is significant and original.

In later chapters, some short literature surveys associated with particular aspects may also be necessary. For instance if you have developed a new experimental technique, in the experimental section you may spend some time explaining why it is original and comparing it with other well-known techniques.

2.6. Conclusions

Be intellectually honest and upfront in your conclusions. State both the advantages of your proposed concepts but also any limitations/challenges. There are very few new ideas/concepts which are completely new and work perfectly.

2.7. Appendices

Appendices are a good place for :

- listings of important programs : in the main body of your thesis to explain how programs work you should normally either use flowcharts, pseudo code or summarise the key equations,
- detailed circuit diagrams of hardware used
- graphs and tabulated listings of extra experimental data
- etc

3. Details about Writing

3.1. Styling

To maintain a consistent appearance in your thesis for things like the fonts and spacing before and after Chapter/Section/Sub-section titles or captions, it is important to use a consistent set of styles. This is done automatically in packages such as LaTeX, but if using Word, this needs to be set-up by the user. It is recommended that you do this upfront before commencing the writing.

3.2. Tables of Contents/Figures/Tables and Figure/Table/Equation Referencing

Whichever software package you use to write your thesis, it is important to make the maximum use of automatic creation of :

- Tables of Contents
- List of Figures
- List of Tables

as well as automatic numbering of

- Figures
- Tables
- Equations
- References

as well as automatic cross-referencing when referring to :

- Chapters/Sections/Subsections
- Figures
- Tables
- Equations
- References

By doing this, this will save you considerable effort if you need to re-arrange parts of your thesis (say shift Section 3.4 to Chapter 2) or add an extra figure or reference at the last moment.

3.3. References

It is recommended to use some form of automatic referencing software such as Bibtex for Latex or EndNote for Word. This will allow easy changes to references without having to renumber all the references in your thesis.

3.4. Nomenclature

At the start of each thesis should be a nomenclature section in which every symbol and abbreviation used in the thesis is defined.

Within the thesis itself the normal rules for defining symbols or abbreviations are :

- they should be defined the first time they are used
- they should then be redefined if they have not been used for a chapter or two
- they should be redefined again if they are used in the conclusions (this is because sometimes the conclusions are read without reading through the entire thesis)

Think carefully on whether you need to define an abbreviation. This should only be done if it is used quite often (e.g. more than a dozen times) in your thesis. Thus if you are only using the abbreviation two or three times in your entire thesis is probably not worth while using an abbreviation (unless the abbreviation is in common use in the field).

When writing your thesis it is recommended that every time you use a new symbol you add it to the nomenclature list. This solves two possible problems :

- defining two symbols for the same quantity
- using the same symbol for two different quantities : note that this can be acceptable if the quantities are clearly distinguishable. For instance *E* is commonly used in machines to

mean induced voltage, while when discussing mechanical design it is commonly used for the modulus of elasticity.

3.5. Figures

Try to keep a consistent styling in terms of font, size and layout of figures. This will make your thesis look a lot more professional and avoid having to constantly revise figure styles during your thesis writing stage.

An idea suggested by Ameen that he used to keep consistency in his Matlab figures is to have a template frame with the specified dimensions and font size. Whenever he generated a new plot, he just copied the plot in the template frame and saved it with a different name.

3.6. Introductory Figure

One concept which has proved useful in the past is to think about a single figure which can be used to describe to a lay person what your research is about. This can be very simplified but should capture the essential elements of what you are doing. This can then make a useful first figure in your thesis and along with a clear, concise description, can form an excellent beginning for your thesis.

3.7. Flow Between Chapters

Chapters should normally have some sort of conclusions along with a short "lead-in" to the next chapter. An example of a "lead-in" is , "… this chapter has described three analysis methods which can be used to predict the machine performance and in the next chapter we will now compare the predictions with experimental results."

When writing any part of your thesis it is important to use the detailed outline to understand how it fits in with the rest of the thesis and what are the key points you are trying to convey. A good understanding of this will help make the thesis sound more coherent and easy to understand, even if it is not written in precise sequence, and avoid writing material which is not necessary.

3.8. Self-Proof Reading

A useful habit when re-reading one's own work is to try to pretend that you are reading someone else's work and that you don't know much about the topic. You should then careful read the material checking for :

- common grammatical/spelling errors
- ease of understanding of material
- logical flow of ideas
- poor quality figures
- abbreviations/concepts which are suddenly introduced without explanation
- extra spaces between words such as this.

3.9. Comments

When giving a chapter or section to your supervisor for comments, it may be helpful to include a copy of your detailed thesis contents so that they can easy see how this section fits into the entire thesis. This is particularly important if you are not starting in Chapter 1.