Forschungspraxis Title

Student Name
Technical University of Munich
TUM School of Computation, Information and Technology
Chair of Automatic Control Engineering (LSR)
Munich, Germany
student.email@tum.de

***Abstract*—Here comes the abstract.**
***Index Terms*—provide a few keywords describing your work**

I. Introduction

Your first chapter in the document. Introduce the problem (gently!). Try to give the reader an appreciation of the difficulty, and an idea of how you will go about it. It is like the overture of an opera: it plays on all the relevant themes.

Make sure you clearly state the vision/aims of your work, which problem you are trying to solve, and why it is important. While the introduction is the part that is read first (ignoring title and abstract), it is usually best written last (when you actually know what you have really achieved). Remember, it is the first thing that is read and will have a major influence on the how the reader approaches your work. If you bore them now, you have most likely lost them already. If you make outrageous claims, pretend to solve the world's problems, etc, you are likely fighting an uphill battle later on. Also, make sure you pick up any threads spun in the introduction later on, to ensure that the reader thinks they get what they have been promised. Do not create an expectation that you will deliver more than you actually do. Remember, the reader may be your marker (of a thesis) or referee (of a paper), and you do not want to annoy them.

II. Problem Statement

You can either state the problem you are trying to solve in the general introduction, providing the transition from the overall picture to your specific approach, or state it in a separate section. Even if you do not use the separate section, writing down in a few sentences why the problem you are trying to solve is actually hard and has not been solved before can give you a better idea of how to approach the topic. This can be also merged with the related work part.

III. Related Work

From Kevin Elphinstone's *A Small Guide to Writing Your Thesis* [**?**]:

"The related work section (sometimes called literature review) is just that, a review of work related to the problem you are attempting to solve. It should identify and evaluate past approaches to the problem. It should also identify similar solutions to yours that have been applied to other problems not necessarily directly related to the one your solving. Reviewing the successes or limitations of your proposed solution in other contexts provides important understanding that should result in avoiding past mistakes, taking advantage of previous successes, and most importantly, potentially improving your solution or the technique in general when applied in your context and others.

In addition to the obvious purpose indicated, the related work section also can serve to:

- justify that the problem exists by example and argument
- motivate interest in your work by demonstrating relevance and importance
- identify the important issues
- provide background to your solution

Any remaining doubts over the existence, justification, motivation, or relevance of your thesis topic or problem at the end of the introduction should be gone by the end of related work section.

Note that a literature review is just that, a review. It is not a list of papers and a description of their contents! A literature review should critique, categorize, evaluate, and summarize work related to your thesis. Related work is also not a brain dump of everything you know in the field. You are not writing a textbook; only include information directly related to your topic, problem, or solution."

Note: Write literature review at an early stage of your project to build on the knowledge of others, not reinvent the wheel over and over again! There is nothing more frustrating after weeks or months of hard work to find that your great solution has been published 5 years ago and is considered old news or that there is a method known that produces superior results.

IV. Problem Setup

Define your problem setup here.

V. Technical Approach

VI. Design of your solution

Having explained the problem, and what others have done in similar situations, now explain your approach. Again, give a general overview of your design first, and then go into detail. The important part here is the concept of your work, not the actual implementation! Make sure that the document (particularly a thesis) is self-contained: It should be possible

for a reader familiar with the general area to understand your design. Again, be forthright about the limitations of your design. Also, make sure you justify any shortcuts/limitations convincingly.

VII. Implementation

In many (not all cases) there is a clear difference between the general approach (design) and its implementation in your particular circumstances. The design may be more general than what you can do given time and resources. Or you have developed a general design, and are now implementing a prototype on particular hardware. Give all required details. It should be possible to understand all this without referring to the source code.

This will, in general, include extracts of actual algorithms and hardware components used. Do not list pages of C code, an electronic copy of the source will accompany the submission and should be available to the marker, so there is no point in killing extra trees to put it into the report. Source code, if included at all, goes into the appendix and not the main document.

Make sure you describe your implementation in enough detail. Someone who has nothing else but your thesis report to go by should be able to repeat your work, and arrive at essentially the same implementation. Reproducibility is an important component of scientific work. Also, clearly state the limitations of your implementation, and justify them.

VIII. Evaluation

IX. Experimental Results

A thesis almost always has an experimental part, typically some comparison to other approaches. Benchmarking takes time, for running the experiments, but also for thinking them up in the first place, and for analysing the results. Plan accordingly to spend enough time here!

Think about what makes sense to measure, what you want to learn from your measurements. Think about what is really the relevant contribution of your thesis, and how you can prove that you have achieved your goals. Think about what you can measure in order to get a good insight into the performance of various aspects of your design, how you can distinguish between systematic and accidental effects, how you can convince yourself that your results are right. If you get surprising results, do not just say "surprise, surprise, performance isn't as good as hoped". Find out why. Surprises without explanation indicate either that you are clueless about what is going on, or that you have made a mistake. Unconvincing results, therefore, tend to imply unconvincing marks.

a) Statistics:: Measurements always have statistical (sampling) errors. Owing to the deterministic nature of simulations these are sometimes very small, as disturbing factors can be designed. However, the reader should be given an indication of how statistically significant the results are. This is done by providing at least a standard deviation in addition to averages. Whenever the results of several runs are averaged, a standard deviation can (and must) be supplied. After all, you average to reduce statistical errors.

The reproducibility argument applies here just as much as for the implementation. Give enough detail on what you measure, and how you measure it, so that someone who has your implementation (but not your test code) or has redone your implementation independently, should be able to repeat your measurements and arrive at essentially the same results. In some cases, results seem outright wrong in a thesis. In those cases, not enough detail is provided to allow the supervisor/reader to pinpoint the likely source of the error. Often the cause is systematic errors resulting from an incorrect measurement technique. If it seems wrong, and the text does not convince the reader that it is not wrong, the reader will assume that it is wrong.

X. Discussion

Discuss and explain your results. Show how they support your thesis (or, if they do not, give a convincing explanation). It is important to separate objective facts clearly from their discussion (which is bound to contain subjective opinion). If the reader does not understand your results, reconsider if you have managed to extract the core information and explain it in a straightforward way.

XI. Conclusion

Do not just leave it at the discussion: discuss what you/the reader can learn from the results. Draw some real conclusions. Separate discussion/interpretation of the results clearly from the conclusions you draw from them. (So-called "conclusion creep" tends to upset reviewers. It means surrendering your scientific objectivity.) Identify all shortcomings/limitations of your work, and discuss how they could be fixed ("future work"). It is not a sign of weakness of your work if you clearly analyze and state the limitations. Informed readers will notice them anyway and draw their own conclusions if not addressed properly.

Recap: do not stick to this structure at all cost. Also, remember that the thesis must be:

- honest, stating clearly all limitations
- self–contained, do not write just for the locals, do not assume that the reader has read the same literature as you, do not let the reader work out the details for themselves

This chapter is followed by the list of figures and the bibliography. If you are using acronyms, listing them (with the expanded full name) before the bibliography is also a good idea. The acronyms package helps with consistency and an automatic listing.