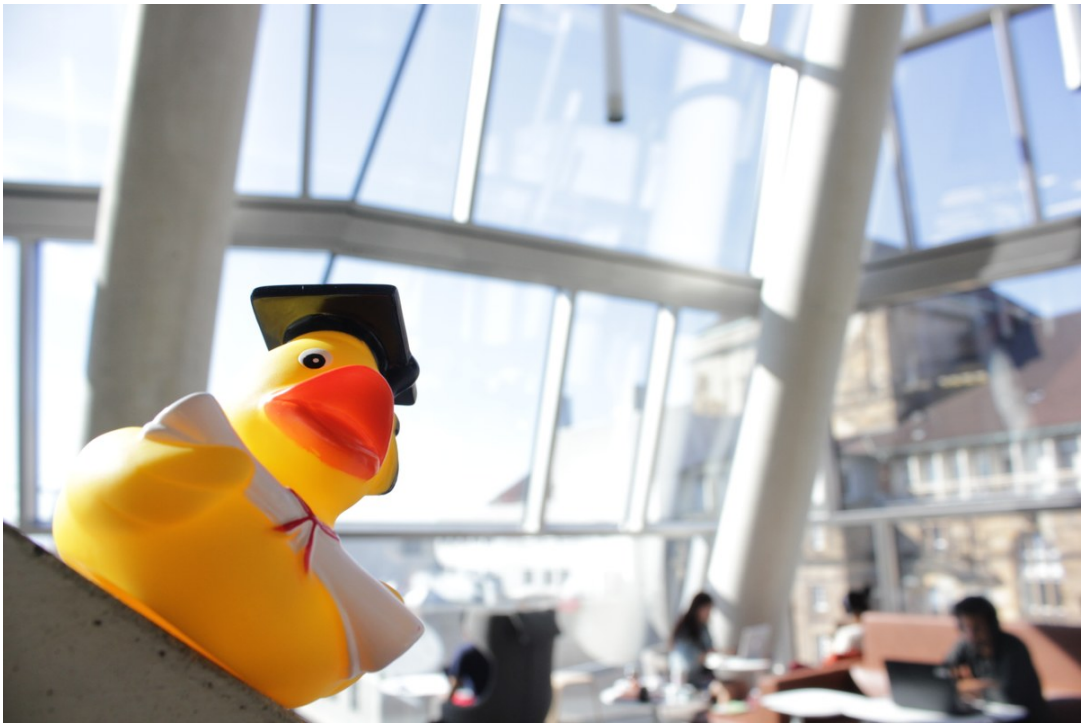
Master's Thesis Preparation Guideline

Chair for Control and Integration of Grids, INATECH



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Preamble

This guideline outlines the specific procedures for supervising Master's theses at the Chair for Control and Integration of Grids (CIG), a division of the Department of Sustainable Systems Engineering (INATECH). It is important to note that this document complements, but does not replace, other applicable regulations. These include the general examination regulations and the specific regulations for programs such as Sustainable Systems Engineering (SSE), Renewable Energy Engineering and Management (REM), and Solar Energy Engineering (SEE). Additional guidelines may also apply and should be consulted.

Disclaimer: Students are responsible for independently obtaining and familiarizing themselves with all official examination regulations. This CIG guideline is meant to support, not substitute, that process. It is also strongly recommended that students consult resources on good scientific writing to ensure their thesis meets high academic standards.

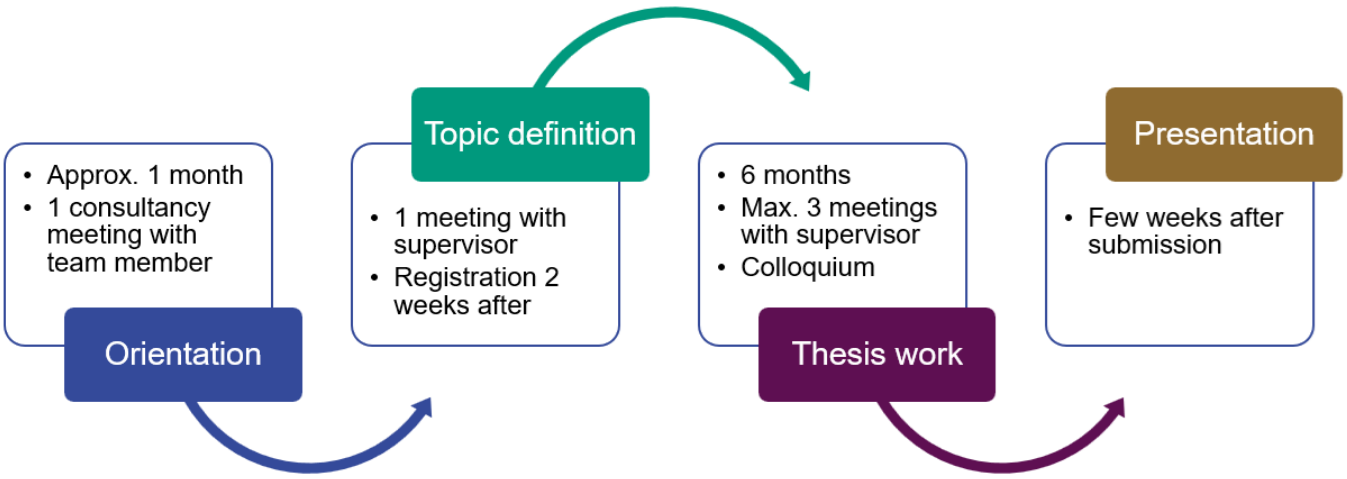

Figure 1: Overall thesis process

Figure 1 provides an overview of the entire thesis process as followed at the Chair for Control and Integration of Grids. The detailed procedures are explained in this document.

1 Before starting the thesis

The first step in preparing for your Master's thesis is selecting a topic and choosing a supervisor. Guidance on how to approach these tasks is provided in Sections 1.1 and 1.2. Additional information on confidentiality agreements can be found in Section 1.3.

1.1 Defining the thesis topic

There are several ways to define a thesis topic. Within the INATECH team, a range of topics related to ongoing or planned research projects is offered each semester. These topics are not always **publicly announced** but can be made available **upon request**.

Many students also find **external Master's thesis positions** and seek supervision from CIG. It's important to note that such positions are independent of the academic thesis work, so students should contact potential university supervisors as early as possible. Supervision for a specific topic cannot be guaranteed. However, if the external thesis position is within a research area related to CIG's work, the thesis topic can be closely aligned with the job. Students must manage both tasks carefully, as the requirements for the thesis and the external position may differ.

Students interested in supervision by CIG are encouraged to schedule a **consultation meeting** to discuss potential research directions. The initial contact can be made via email (to anke.weidlich@inatech.uni-freiburg.de), and should include the following information:

- Study program and current semester,
- Bachelor's degree major,
- Completed elective courses,
- Special skills, programming experience, work experience, or other relevant details,
- Current transcript of records (as an attachment).

The goal of the consultation meeting is to either identify a potential research direction or to determine whether a proposed external topic aligns with CIG's scope and is suitable for a scientific thesis. Relevant literature recommendations may also be provided during this discussion. If a suitable topic is identified, a follow-up meeting with the supervisor should be arranged to move forward with the thesis planning process.

1.2 Finding a supervisor and registering the thesis

Students are responsible for choosing both their first examiner, who will also serve as their thesis supervisor, and a second examiner for their Master's thesis. Examiners must be professors or lecturers with special permission to examine theses. At the Chair for Control and Integration of Grids (CIG), these are:

- Prof. Dr. Anke Weidlich
- Dr. Mirko Schäfer

However, according to examination guidelines, Prof. Dr. Anke Weidlich and Dr. Mirko Schäfer cannot both serve as the first and second examiner for the same thesis. Therefore, students must find an additional second examiner. In certain cases, external examiners from other universities may also be involved.

The **thesis topic is officially issued** during a meeting with the selected first examiner. If the thesis is conducted in collaboration with an external institute or company, it is recommended that relevant collaborators participate in this meeting. Following the examination regulations, students must **formally register their thesis** within two weeks of the topic issuance (for SSE students, this deadline is one week only). SSE students should note that they must first request the thesis registration form from the examinations office. As this process may take some time, it is advisable to initiate the request well in advance.

It is advisable to secure a second examiner as soon as possible. If the proposed examiner agrees, their name can be added to the registration form. If the examiner declines or fails to respond, the second examiner may be registered later in the SSE and SEE programs (this flexibility does not apply to REM). The date of the topic assignment is the day of the initial meeting.

In addition to the official supervisor (first examiner), students may also be assigned a **scientific advisor** from the CIG team. The advisor will be determined when the thesis topic is is-

sued and will serve as the primary contact for the student throughout the thesis process. A list of CIG team members can be found at the CIG website.

Once the thesis is registered, the student will be enrolled in the **ILIAS course for final theses at CIG** by Viola Gartner. All supervision-related information, including invitations to colloquia, will be communicated via ILIAS.

1.3 NDAs, confidentiality clauses, supervision confirmation

Some companies or institutes offering Master's thesis positions may require supervisors to sign **non-disclosure agreements** (NDAs) or similar confidentiality arrangements. Additionally, they may request that the thesis be protected by a confidentiality clause, preventing its publication. The CIG team does not support such agreements. We strongly advise defining the thesis topic in a way that allows for generic formulations and the use of non-confidential, exemplary data. Since a Master's thesis is a scientific document, it should be accessible to interested readers.

Some institutions also request that professors **confirm in advance that the proposed topic is accepted** and that the student will be supervised on that topic, making this confirmation a prerequisite for the thesis contract. At CIG, we do not agree to such commitments. The university officially issues the thesis topic, and only after that can the thesis work formally begin. However, we encourage students to arrange preliminary meetings with their local supervisor and CIG examiners. This collaborative approach allows us to define the topic together, ensuring it meets both academic standards and the requirements of the external institution. This process also ensures that all parties can confirm their engagement before the thesis begins.

2 During the thesis work

This section provides an overview of key requirements and resources to support students during their thesis work. Guidelines for the mid-term and final presentations are outlined in Section 2.1. Additionally, the CIG team offers support throughout the thesis process, as described in Section 2.2. Best practices for thesis writing are summarized in Sections 2.3 to 2.6. Students are also strongly encouraged to consult additional resources to enhance their writing skills.

2.1 Colloquium

The Master's colloquium, held irregularly, is a key component of the thesis process. Each student is required to present their thesis progress at least once during their work. **We consider this colloquium an essential part of the thesis project and, therefore, require all students supervised by CIG (i.e., whose first examiner is from CIG) to attend all colloquia throughout their thesis work.**

Ideally, each student's presentation occurs around the end of the third month of thesis work. The primary goal is to provide an overview of the research conducted so far and outline the next steps, allowing for any necessary adjustments to be made early.

The colloquium is also an opportunity for students to learn from their peers, exchange ideas, and share useful resources such as research papers or data. Common challenges, questions, and issues related to academic writing are discussed during these sessions, facilitated by a PhD student from the CIG team.

The mid-term **presentation should last 15 minutes**, followed by up to **10 minutes of discussion**. The presentation should introduce the topic, summarize progress, and outline the planned approach for the remainder of the thesis. Students are encouraged to ask questions during their presentation to generate discussion, particularly when multiple approaches are possible, and feedback is needed on the best course of action. **All slides should be numbered** to make it easier to reference specific points during the discussion.

2.2 Consulting and feedback

During the thesis work, students are encouraged to request consultations with their supervisor on any thesis-related topics. Up to three **meetings with the first examiner** can be scheduled. For each meeting, students should bring the latest version of their table of contents and a prepared list of questions. After each meeting, students are required to summarize the key points and decisions discussed. This summary should be sent via email to the examiner (Prof. Anke Weidlich or Dr. Mirko Schäfer) and copied to the scientific advisor, if applicable. Additional meetings with the scientific advisor can be arranged directly with that person, and meeting summaries should also be sent to both the advisor and supervisor.

As an additional feedback opportunity, students can submit a **sample text of up to five pages**, along with the current table of contents and reference list, to the first examiner for review. This sample should be proofread by another academically proficient individual, such as

a fellow student, before submission. The document must include the current thesis title and should be accompanied by the following information:

- Confirmation that the guidelines in this document have been read and followed.
- A statement that the sample text has been reviewed by a fellow student or another academically qualified person, along with the name of the reviewer (with their permission).
- Any specific questions or areas where feedback is desired.

The sample text can be submitted at any time via email to the scientific advisor, or to the examiner if no advisor has been assigned. Feedback will be provided within two weeks. Students should apply any general comments from this review to the rest of the thesis. Therefore, it is recommended that the sample text be submitted at least one month before the thesis submission deadline.

2.3 Thesis structure

Every thesis should adhere to a standardized structure, much like scientific articles, which typically follow a common format. They begin with an introduction, review the current state of research (often termed “related work”), outline the applied methodology, present results, discuss the findings, and conclude. Below is a breakdown of the key components that should be included in the thesis.

- **Abstract**: A concise summary of the research question, chosen approach, key findings, and their interpretation. The abstract should be no more than one page long. While optional, including an abstract is highly recommended, particularly if there is an intention to publish the thesis as a research paper. It is best to write the abstract after completing the other sections of the thesis.
- **Table of contents** (ToC): Provides an overview of the thesis structure with corresponding page numbers. If appendices are included, they must also appear in the ToC. The ToC is an unnumbered section and does not appear within itself.
- **Tables of figures and tables**: Following the ToC, these sections list all figures and tables used in the thesis, along with their respective page numbers. These are also unnumbered sections and should be included in the ToC.

- **Introduction**: Outlines the problem statement and scientific objectives, presents the research questions, and explains their relevance. It summarizes the chosen methodology and offers a brief overview of the thesis structure. The introduction is the first numbered chapter, with page numbering starting at 1. Front matter pages typically use Roman numerals.

- **Related work**: A critical review of relevant literature, covering key methodological developments and prior research findings related to the thesis topic. For further guidance on conducting literature reviews, refer to Section 2.4.

- **Methods**: Details the approach taken to answer the research questions. It should include all necessary mathematical equations and a comprehensive description of data collection, creation, and analysis. The goal is to provide enough information for the reader to replicate the approach and obtain similar results.

- **Results and discussion**: Results should be presented as objectively as possible, without mixing interpretation or discussion. Tables and figures are essential for summarizing findings and must be referenced in the main text. The text should remain understandable without these visual aids, but they should enhance the reader's comprehension. The results section is followed by a discussion that places the findings in the context of the research questions.

- **Conclusions**: Highlights the most significant insights gained from the research, reflecting on the implications of the results, offering suggestions for future research, and acknowledging any limitations of the study (e.g., how the chosen methods may have affected the findings).

- **Bibliography/References**: Lists all cited literature and their bibliographic information (refer to Section 2.4 for more details). This is an unnumbered chapter.

- **Appendix**: Contains supplementary information that is not critical to understanding the thesis argument but adds value for the reader. This may include alternative scenario results, original data sources, or the code used for generating results.

Several of these sections can be split into multiple chapters. For instance, the results and discussion may be divided into separate chapters, or the methods section may be further subdi-

vided. Structuring a thesis into chapters and sections can be challenging, as there are no absolute rules. However, considering the purpose of structuring and following logical principles can help. Below are some guidelines on structuring:

- The smallest structural unit is the **sentence**, conveying a complete thought. **Paragraphs** consist of several sentences and should represent a single idea. Students sometimes break their text into too many paragraphs, some containing just one sentence. This hinders the communication of complex ideas. A paragraph should develop a complete idea, not merely a sentence.

- **Numbered elements** in the thesis include chapters and (sub)sections. Subdividing a chapter into sections is appropriate when multiple subtopics of equal abstraction comprise the chapter's subject. Lower-level sections should be consistent in theme and separated uniformly. For instance, if the results for multiple scenarios are being compared, each scenario should have its subsection, with no unrelated subsection at the same level. No content should be presented directly in the higher-level section header; it should only introduce the subsections. Importantly, **a section must have at least two subsections if subdivided**. Additionally, subsections should not be too brief; a good rule of thumb is that each should contain at least 1.5 pages of content. Typically, three levels of subdivision suffice for most theses, and both the introduction and conclusion chapters should remain undivided.

- **Headers** should follow a consistent style and use of capitalization. They should be as descriptive as possible, making it easy for the reader to locate specific content.

- According to ISO 2145, a period separates numbers in section headings to indicate different levels (e.g., 1.1, 1.1.1). **No period follows the final number in a heading** (e.g., 1 Introduction, not 1. Introduction).

- Finally, a thesis should have a clear and descriptive **title** that accurately reflects the scope of your work. Chapter and section titles should differ from the thesis title, as each title should specifically reflect the content of its section. The thesis title established at registration is a working title and may be adjusted as the scope evolves, in consultation with the supervisor. The final title may deviate from the original, reflecting the refined focus of the completed work.

2.4 Literature review and citations

A strong scientific thesis is built upon **high-quality literature**. Such literature is typically found in peer-reviewed journals from reputable publishers like Elsevier, Springer, IEEE, and other academic institutions. Excellent starting points for finding these articles include databases such as ScienceDirect, Web of Science, or IEEE Xplore. Additionally, it is advisable to use specialized search engines like Google Scholar instead of a general Google search. Another valuable resource is ResearchGate, where authors often share full-text versions of their publications. However, care must be taken to ensure that the uploaded articles are peer-reviewed and not unreviewed preprints. If in doubt, the CIG team is available to help distinguish between high-quality and less reliable sources. Access to many papers through the aforementioned databases may require a subscription. Fortunately, the university library subscribes to numerous journals, and students can access these resources from within the university network.[1]

A well-executed **literature review** goes beyond merely summarizing relevant work. It should critically analyze the state of research in a specific domain, identifying trends, gaps, and important developments. Writing a literature review chapter for a Master's thesis shares many similarities with writing a review article. Valuable guidance on writing effective reviews can be found in resources like [1].

When writing a thesis, any statement that is not common knowledge or derived from the author's own research must be properly referenced. **Direct quotations** should be avoided unless absolutely necessary. Quoting is appropriate when paraphrasing would significantly alter the meaning of the original statement or when citing historically important language. For example, a quote like Albert Einstein's famous saying, "Everything is energy and that's all there is to it," may warrant direct citation. However, in fields like engineering and natural sciences, where the focus is typically on conveying information clearly and succinctly, **paraphrasing and summarizing** are preferred over direct quotes.

Two major **citation styles** are common in engineering disciplines: the Harvard style (author, year) and the Vancouver style, also known as the IEEE style (numbering). Although no specific style is mandated, it is crucial to choose one and apply it consistently throughout the thesis. At the end of the thesis, a comprehensive **reference list** must be included, detailing all cited works such as journal articles, books, reports, and web pages. This reference list is an unnumbered chapter, but it must appear in the table of contents.

[1] Accessing these journals from a private computer is also possible via a VPN connection. For instructions, refer to `https://www.rz.uni-freiburg.de/en/services/netztel-en/vpn-1?set_language=en`

2.5 Scientific writing and the use of AI tools

There are many excellent resources available that provide guidance on scientific writing, e.g., [2, 3, 4, 5, 6]. Students are encouraged to **consult at least one book** on effective writing styles and to follow the advice offered in these texts.

It is important to consider the target audience for your thesis. While your examiners are experts in the general field your thesis addresses, they may not be familiar with every specific aspect or method you explore. The introduction and conclusion should be written with a broader audience in mind, while the core sections should be targeted toward experts in your specific area of study.

Based on extensive experience with reviewing theses, it is clear that **lengthy motivation sections – covering topics such as the energy transition, the development of renewable energy integration, the Paris Agreement, or the 1.5-degree Celsius target – are often unnecessary**. A single sentence that briefly sets the context will suffice. Instead, the introduction should **focus on motivating your specific research questions** rather than reiterating broad concepts related to energy transition or sustainability, unless these topics are central to your thesis.

The rapid advancement of AI tools, such as ChatGPT and other large language models, has made it increasingly common for students to incorporate these tools into their thesis work. However, the **use of AI does not change the fundamental principles of academic integrity**. Instead, AI tools should be viewed as an extension of the resources already available to students, requiring responsible and knowledgeable use. Just as you might use a calculator or Excel for performing calculations, **you can use AI tools like ChatGPT to refine the language and style** of your thesis writing.[2]

That said, just as it would be unacceptable to have a friend write your thesis or sections of it for you, it is equally **impermissible to submit large portions of text generated entirely by AI**, such as the entire related work section. Such practices constitute academic misconduct and could, in extreme cases, result in serious consequences such as expulsion. Between zero usage and clear misuse of AI tools, there is a broad spectrum of acceptable and unacceptable practices. If you're unsure, consider the following guidelines:

[2] In fact, this document was created with the assistance of ChatGPT for precisely this purpose: to improve the English formulations of a non-native speaker.

- **Examiners at CIG have extensive experience** in reviewing and evaluating Master's theses (having supervised over 200 theses). Over-reliance on AI tools is likely to be noticed and will raise concerns about the overall quality and originality of the work.

- If you're uncertain about what's acceptable, **consult your academic advisor or examiner**. Discussing best practices for AI use is part of the supervision process. Additionally, as AI tools continue to evolve, so do the guidelines for their use, and it is important to stay informed.

In summary, AI tools can be helpful for enhancing your thesis, but they must be used ethically and within the boundaries of academic integrity. Always strive to balance the benefits of AI assistance with your responsibility to produce original and thoughtful work.

It is **essential to clearly disclose any use of AI tools**. In the **declaration** within your thesis, you state, "... that no other sources or aids, beyond those listed, have been used." If AI tools are used for anything beyond language and spell-checking, this must be explicitly acknowledged. While the University of Freiburg does not provide an official declaration addressing AI tool usage, this does not exempt you from disclosing any assistance received from such tools. The FU Berlin (link) offers a good example of an AI disclosure statement, which should be included in your declaration if you have used AI tools.

2.6 Thesis length and submission

There is no fixed page requirement for a thesis, but at CIG, **brevity is valued**. A concise thesis encourages the writer to focus on the most critical aspects and express them clearly and precisely. In many cases, a well-written thesis can be effectively presented within 40–50 pages, depending on the topic and formatting. However, the thesis should generally not exceed 80 pages, from the first page of the introduction to the final page of the conclusion.

For environmental reasons, **double-sided printing is encouraged**, as it helps conserve paper and save trees. Additionally, electronic submission is either recommended or mandatory, depending on the specific regulations of the study program. At CIG, the preferred method for **electronic submission is via email** to the first examiner, with the thesis provided as a single PDF file attachment.

3 After submitting the thesis

The final step towards graduation is the **thesis defense**, which can take place no sooner than three weeks after the thesis submission. This timeframe ensures that examiners have sufficient time to thoroughly review the document before the defense. The presentation should last 20 minutes, with all slides numbered for easy reference. A total of one hour is allocated for the defense, ensuring ample time for questions and discussion. Ideally, the second examiner will attend the presentation, and all students with either their first or second examiner from the Chair of Control and Integration of Grids are encouraged to participate. Attending the defense of others provides valuable insight into the process and can offer inspiration for your own work.

To schedule the final presentation, please send an email request to Viola Gartner and the second examiner (or their secretary). Ideally, both examiners should be present at the defense. **Thesis grading** typically occurs within six weeks of submission, although this timeline can occasionally be challenging to meet if many theses are under review. Nevertheless, the colloquium date will be recognized as the official graduation date, and students will be informed immediately if they have passed the thesis and defense.

If students wish to avoid paying **tuition fees** for a new semester when their only remaining examination is the thesis and defense, there are two options. The first is to schedule the presentation before October 1st (for the winter semester) or April 1st (for the summer semester). This allows for **exmatriculation** before the semester begins, avoiding tuition fees. The second option is to present within the first four weeks of the new semester (typically mid-May or mid-November). In this case, the tuition fee can be reimbursed if the student promptly requests immediate exmatriculation.

References

[1] J Webster and RT Watson. Analyzing the past to prepare for the future: Writing a literature review. *MIS Quarterly*, 26(2):xiii–xxiii, 2002.

[2] GD Gopen and JA Swan. The science of scientific writing. *American Scientist*, 78(6):550–558, 1990.

[3] George M Whitesides. Whitesides' group: writing a paper. *Advanced Materials*, 16(15):1375–1377, 2004.

[4] Duke Graduate School. Scientific Writing Resource. `https://cgi.duke.edu/web/sciwriting/index.php`, 2013.

[5] H Silyn-Roberts. *Writing for science and engineering: Papers, presentations and reports*. Newnes, 2012.

[6] SA Socolofsky. How to write a research journal article in engineering and science. *Texas A & M University*, 2004.