



Guide to Taking the Ph.D. Exams

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March 23, 2021

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1 Introduction

The Ph.D. program in our department has 3 major milestones:

1. preliminary exam
2. comprehensive exam
3. defense exam

This document provides some guidelines and expectations for AVS lab students to prepare for the comprehensive and defense exams.

2 Official Exam Information

The [graduate handbook](#) for your entry year is the source for any official exam expectations, rules, etc. Be sure to read this carefully when considering taking this exam.

3 Getting a Ph.D. Committee Formed

The doctoral committee typically consists of 5 members of which 3 must be regular ASEN faculty and one must be a non-ASEN faculty. The later can be a CU professor, or someone outside of the university with the proper qualification.

3.1 Adding CU Professors

Any regular appointment CU professor can be part of your committee. Select faculty that are at least interested in your research topic. You likely won't have 5 members who are all experts on all components of your dissertation. That is ok. Find faculty who understand the general field, but researchers close to your studies are always preferred. The non-ASEN faculty in particular is there for a general checks-and-balances of the exam process. They don't have to be an expert in your field, but should be familiar with the general field of research. For example, don't pick an English professor for an orbital mechanics dissertation, but any professor understanding dynamics and control could participate.

3.2 Adding Non-CU Professors

The non-CU outside person must have a Ph.D. degree and have published in journals in the recent years. Note that this person will need to have a special graduate school appointment setup to serve on your committee. The process is pretty straight forward, just check with your graduate advisor. The graduate school will ask for their CV which should show their recent publication history and degrees earned. Once setup, they have a multi-year appointment so this only has to get done once.

3.3 Reaching out to Potential Committee Members

After you have discussed your Ph.D. committee member choices with your advisor and received a thumbs-up to proceed, the next step is to formalize the committee. Don't just assume someone will agree to serve on your committee, be sure to reach out to them well in advance of the comp exam to request they join your committee. This contacting can be done via email or in person, that is up to you. Either way, politely approach the professor with the request, and provide them with the following information. You should inform the candidate committee member of:

- what your dissertation topic is
- timeline when you plan to do the comp and defense
- offer to chat in person if desired.

Once the committee is established, it typically only meets at the doctoral exams. You are free to reach out to committee members in between these exams to discuss research that might be of interest to them, or to get research feedback yourself.

4 Comprehensive Exam

4.1 Overview

The comp exam is ultimately a research proposal to your committee. Here you are pitching your research proposal to the committee who then sign off that your research scope is sufficient for a doctoral degree. This is done both through the written prospectus and the oral exam component. The overall goals include:

1. *Topic Selection:* Is the research topic suitable for a degree in aerospace engineering.
2. *Novelty:* The doctoral research must advance the state of the art. Show through the related literature review that the proposed work is new and novel. It helps as well if you have already published journal papers, but that is not required at this stage.
3. *Ph.D. Hard:* Is there enough technical "beef" in this dissertation. The work you pitch must be challenging enough to warrant a multi-year doctoral program. In astrodynamics you should expect to publish at least three journal papers worth of work. Many do lots of papers.
4. *Are you qualified:* You demonstrate this by having 50-75% of the work done. Show good knowledge of the related field, be able to answer questions, show results of work you have already completed.
5. *Research Scope:* You need to be very clear about what this dissertation is about. What are the key tasks that will be done. What research goals are critical to your work, what goals are stretch goals?
6. *Research Timeline:* Show a GANTT chart how the remainder of your dissertation will play out. When do you present conference and journal papers, when do you plan to defend, do you have a plan if something doesn't happen as expected.

4.2 Prospectus

The prospectus is a written document of 15-20 page length. This does not include the bibliography. This length is typically tight and you can't be too detailed. Review the above goals and make sure you allocate appropriate space for each component. Try to use 11pt font if possible. I won't accept any fonts less than 10pt.

While you can't give a 20-page mathematical discussion of your results, do include some mathematics to layout key developments, but then show what results you got and what you learned.

For future work show a plan of attack on what you plan to do, how you plan to approach this. etc.

Regarding timeline, you should provide the prospectus to your committee one week for the comp exam. Add extra time for your advisor to read and approve the prospectus. We typically iterate a few times on this before it is done, so have a draft ready at least 3 weeks before the exam.

4.3 Oral Exam

To schedule the oral exam, you must register for this exam with the graduate school who signs off on the Ph.D. committee. Check with your graduate advisor on the latest process, paper work and timelines

For the exam, schedule a 2h meeting. The oral presentation should be around 45min. This leave 15min for general Q&A, 40min for Q&A with the committee, and 20min for the committee to discuss and decide the outcome.

When creating the presentation, be sure to provide a few slides showing the motivation, show good knowledge of related work, highlight what is novel. Then you get into the technical goals of the dissertation showing why you are capable, what assumptions and methods you are using, discuss results obtained so far.

Future work is always more fuzzy at this stage, do your best to outline what you expect will happen. You can illustrate some early technical approaches, ideas, experiments, simulation developments, etc. Discuss the scope of this work and what you see as the biggest unknowns.

Be sure to include a GANTT chart in the presentation as well. Don't rush through this! Here is your chance to summarize to the committee what your goals are, what are stretch goals, and show what will happen between now and defense. It is always nice to illustrate what are items you think are low-risk or high-risk.

5 Ph.D. Defense

5.1 Overview

Congratulations, you are close to the end! Now it is time to put the multi-year research project into a comprehensive written document, i.e. the dissertation, as well as an oral defense.

Reach out to the committee multiple months in advance to lock in on a defense time. This often becomes a challenging task with competing schedules. We can integrate committee members via video chat software like Zoom if needed. Non-CU members don't have to travel to CU, but are welcome to join us in person.

Check with your graduate advisor on what deadlines and paper work must be considered.

5.2 Dissertation Writing

There is no length limit with the dissertation, thus be generous in your use of white space and research presentation. However, have mercy and try not to be too verbose. The story should carry the length. The documents are often between 135-200 pages.

Start putting the outline of the document together 4-6 months before the defense. The prospectus gave you a general blue print, but you can now refine the chapter and section layout as needed.

Use the CU thesis T_EX template from the beginning. This saves you lots of time. You can often start by copying and pasting the papers you have published into chapters and sections. This is where using T_EX will be very helpful. But you will need to edit the paper content to make it flow properly with the rest of the content. As you develop a skeleton outline of the dissertation seek an opportunity to discuss this with your advisor. You may choose to shift the order of the technical content to improve the story line.

Use the best practices you learned over the year regarding technical writing including:

- Use present tense when doing technical writing unless you discuss specific past event, or talking about future work
- Make sure figures are of publication quality
- The dissertation is long. Try to start the chapters with a quick intro and motivation of what is presented, why this is novel and interesting, and end the chapter with a summary of what is learned and new.
- Be sure to cite your own published papers as well, even if you use the paper as a draft of a chapter.

5.3 Organizing the Oral Exam

Be sure to reach out to the graduate advisor on what all is required to get setup for the final exam. You will need to:

- Coordinate with your Ph.D. committee on a day and 2h time block to do the dissertation defense
- Coordinate with the graduate advisor to get the exam day and time, as well as the committee members, approved by the graduate school. They will provide you with an exam PDF form, send this to me.
- If in person, find a room to hold the exam. If virtual, use either AVS-1 or AVS-2 Zoom channels so I can be the host of this exam Zoom session. Even if the exam is in person, a Zoom setup to include committee members who can't be here in person, or to include family and friends to can't make the defense, is recommended.
- Check with the graduate advisor on how many readers you need for the dissertation. I will be one of them as your academic advisor. Reach out to other committee members to be a reader.

5.4 Taking the Oral Exam

You have about 50min to do the presentation in the oral exam. You should still give a motivation as the committee has not seen your work for a while. For material that you gave a detailed presentation on in the comp oral exam, you can try to summarize these results in the defense oral. This will leave more time to talk about the new results, etc.

At the end it is nice to have a slide that shows where you have published and presented this work. After the conclusions a page on future work would be nice as well.