

PH.D. STUDY AT THE INTERACTIVE ROBOTICS LABORATORY

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The purpose of this document is to help perspective and new Ph.D. students to understand the dynamics and the culture at the WVU Interactive Robotics Laboratory (IRL), and to help existing students to evaluate their progress toward the completion of their degrees. This document is in addition to the university, college, and departmental guidelines on graduate study which can be found on the WVU website.

A. Introduction

Getting a Ph.D. degree is an important decision for a student. In my opinion, not everyone is suitable for a Ph.D. In particular, I would strongly discourage a student from pursuing a Ph.D. degree if his/her main motivation is:

- to get a higher paid job – you could find a job easier without a Ph.D. degree and would most likely be financially more sound to start working a few years ahead;
- to stay in school because you are not sure what else to do – go get a real job!
- to have a title of ‘Dr.’ associated with their names – nothing is cool anymore after you own it.

For the rest of us, who have strong *curiosity* to explore the unknowns, Ph.D. study provides great opportunities. Think about this: you get paid (and tuition waived) to be educated, to work on exciting projects, to buy/build and play with fancy toys, and to interact with other intelligent people! What’s the catch? You have to stay motivated and focused, be creative and diligent, be capable of managing your time and stress, be able to handle failures, and spend a substantial portion of your life reading, thinking, building, programming, writing, and helping others.

B. Objectives

So what should you expect by the time of graduation? You should have:

1. the ability to perform *independent* state-of-the-art research. You should have accumulated enough knowledge of your field of interest to be able to identify new research directions;
2. a clear *vision* of your career path, whether it will be in academia, industry, or government agencies;
3. the ability to effectively convey your ideas and findings both verbally and in writing;
4. a Curriculum Vitae (CV) that is good enough for getting your dream job.

If you are short on any one of these, you are not ready to graduate yet!

C. Action Items

To achieve these objectives, this is what I expect you to be doing during the next a few years:

- *Read*. Reading is the most important way for you to catch up with the fast evolving field. I will provide the initial papers, but you need to find a lot more on your own! Google Scholar is a great place to start. Exploring the reference section of a paper and who cited

it often brings you more papers to read. The more you read, the more you will feel the need to read more (a positive feedback);

- *Think*. Independent thinking is what makes you a scholar. Standing on the shoulders of giants (after reading their papers), we should be able to think just a little bit further (or different);
- *Build*. We are engineers and we create things with our hands. Working with physical systems is very challenging, but is also highly rewarding to see the stuff you built works. You will learn the problem solving skills through solving real world problems;
- *Talk*. This includes ‘asking’ if you have a question; ‘discussion’ if you want other people’s opinions or to bounce ideas off them; and ‘presenting’ of your problems, solutions, results, and conclusions. So speak up, and you will grow faster. To facilitate this, we have bi-weekly meetings at IRL and every student will be asked to present. These meetings allow you to prepare and organize your thoughts, document your work, and keep you up to date on other research activities in the group;
- *Publish*. We should not keep the best only to ourselves. I expect each Ph.D. student to present at least one conference paper per year, and have a minimum of two journal papers accepted for publication before their dissertation defense.

D. Your Responsibilities

We are working as a group. Our long-term survival and reputation depends on many factors. During your Ph.D. study, I expect you to:

1. maintain a high level of motivation and academic integrity;
2. efficiently manage your time and resources;
3. keep a positive, open, and curious mind;
4. be systematic and meticulous in doing research;
5. be responsible and take ownership of your work;
6. be persistent and not discouraged by failures;
7. be professional and respectful;
8. be a good citizen, team player, and willing to help others;
9. keep a clean and safe lab environment.

E. My Responsibilities

As your research advisor, you can count on me to:

1. provide inspirations and general research directions;
2. identify and respect your interest, strength, and limitations;
3. identify interesting, feasible, and clearly-defined research topics;
4. locate resources for conducting the research;
5. monitor progresses, perform quality control, and provide feedback in a timely manner;
6. learn, self-improve, and keep an open mind;
7. provide support for scholarship, fellowship, and job applications;
8. provide career advice and other support;
9. host a yearly picnic :)

F. Stages

In my opinion, the Ph.D. study generally involves three stages:

During the first year, you will be taking most of the required courses. You will also be assigned with detailed tasks. Some tasks will be for training purposes, some will be related to research projects, and others will be related to housekeeping. You are expected to be integrated into the research group quickly. It is always a good idea to ask around and learn something from everyone.

From the second year on, you are expected to grow in your research independence. The tasks that you will be assigned will be at a higher level, without obvious answers. You are expected to read, think, come up with, and test your own solutions. You will also start to play leadership roles in the projects.

From the third year on, I expect you to have a good understanding of the research field, be able to identify gaps in the state-of-the-art, and be able to provide your own contributions. After banging your head against walls in different directions for a few years you will find a wall that might be weakest. This would be the time to write a research proposal, so that you can continue to bang head against that wall until it goes through. At this point, you will know a lot more in your specific research area than I do. You are also expected to help mentor and manage the activities of your junior peers.

In general, you should expect to graduate in 3-5 years if you already have a Master's degree. Direct-track student can expect one additional year (4-6 years).

G. Things to Avoid

You should not treat graduate school as a 9 to 5 job. You will need to spend as much time and effort needed to train yourself and to get the research going. If you are not already working in the lab during nights and weekends, I expect you to spend a significant portion of that time studying at home.

You should not be bothered by seeing other students get away with an easy graduation. If they got a degree without received proper training, they have wasted their time in school. They will simply not be able to compete with hard working students graduating in different university around the world each year.

You should not feel intimidated by people from BNUs (Big Name Universities). We can and should compete with them. That is how you get to work on these exciting projects that were awarded by world-famous organizations, such as NASA. If we were not so good, some group at BNU would be eating our lunch by now. In the future you will end up competing with BNU graduates on the job market anyways, so better be prepared now.

H. Other Random Advices

1. *Failure*. You may actually learn more from a failed experiment than successful ones, as long as you ask the question 'why'. Some people see failures as defeats, others see them as challenges. It is a matter of perspective;

2. *Pressure*. The ability to handle pressure will be an important part of your life. This includes two parts: be productive and self-motivated when the pressure is low, and be effective and positive when the pressure is high;

3. *Writing and Presentation*. Some people may be born with good writing and presentation skills but most people do not. However, everyone can learn to be good at them (at least, in an engineer's world) given enough practice;

4. *Science*. If you are not interested in following general science developments, you are unlikely to be very creative with your own research;

5. *Travel*. The period of graduate study is the best time to see the world. Although you probably don't have too much money, you also probably don't have too many other things to worry about, such as children. I will give you extra vacation time if you present me with a good travel plan;

8. *Health*. Go out and play whenever you have free time!

9. *Self-Doubting is a Human Nature*. Be persistent and you will get over it.