# Master thesis guidelines

The aim of this document is to summarize the most important guidelines for master students that conduct their master thesis at the Vrije Universiteit Brussel (VUB), Master of Science in Electro-mechanical engineering (department MECH), and specialization mechatronics-construction. The list of guidelines presented here is of course non-exhaustive, but provides a decent base to start your master thesis. Any further questions can of course be addressed to your promoter or advisor. Important! You are in the driving seat! This means you need to take initiative to contact assistants and supervisors for assistance, send text for review etc.

## 1 General information

The master thesis accounts for 24 ECT credits. This means that conducting your master thesis should in principle take almost half of your time during your last master year. This is a substantial amount of time and often students consider their master thesis as a chance to prove the best of their skills. During your master thesis you will be guided and supported by your supervisor(s) and advisor(s). Some students might be working in cooperation with a company as well. It is, however, important to realize that producing a fruitful thesis is your own responsibility. We expect you to take the initiative and to function as the leader of your own thesis.

## 2 Timing

As for every big task or project, a good planning and timing is the key to success. A 'standard' outline of a thesis year is as follows:

- During the internship, start with a literature study on your topic. The first papers and research directions will be given by your supervisor(s) and advisor(s). The idea is that after this inspection round you dig deeper into the literature to know the state of the art and to obtain ideas and inspiration. This will help sharpen the goal of the project and allow posing the research questions. Write in this phase the motivation (about 1 page), state of art and research questions of the project. Important is that the state of the art is not a summary of existing work, but this is a study on his own, out of which you have to draw conclusions.
- After studying the state of art, a plan containing timing and research goals have to be made that has to be discussed with your advisor(s) and supervisor(s). This plan can of course change over time, but it gives you guidance and indicators to verify your progress during the year. At this stage also define your final title.
- Depending on your topic you will then start with some first calculations, preliminary design and simulations. Be aware that if special products need to be ordered, that they require some weeks, even months delivery time. So in January a proposal of shopping list has to be presented.

- In December, before the exams, we organize an intermediate presentation to check your progress and future plans. Make sure that you take into account in your planning that January is mostly devoted to your exams. Be aware that after your exams only four months are left to finish all your work.
- Mostly you will also build a prototype or proof of concept. Make sure you start this in time. See section - for more information.
- Important is to validate your research questions, preferable by performing real experiments or by simulations. The experiments and simulations must be compared and discussed. Finding appropriate experiments is a non-trivial task. Part of the design is the validation process.
- Make sure you start writing in time. Regardless of the quality of your work, a thesis is only successful when it is written and presented good as well. See section 4 for more information.
- Early June is the deadline, end of June the oral defense. Archive all material, since this has to be provided together with the dissertation to the supervisor.

# 3 Toolbox

The most valuable 'tool' you have available is yourself. Your thesis is the perfect opportunity to show your engineering capabilities. Furthermore, our lab offers a numerous tools and possibilities to support you:

- **Workshop** Our lab has a professional workshop and two technicians: Marnix and Jeroen. First discuss the technical drawings with your assistants/advisor(s). After approval, discuss your technical drawings with the technicians. Always make sure you provide them fully detailed (all dimensions indicated in large fonts + material details) plans on paper, and your files by email or USB. The workshop is equipped with CNC machines and turning lathes.
- **Computers** Best work on your own laptop. You can of course also use the computer rooms at 3e floor of building K. Concerning Inventor: do not forget to open new files as 'standard (**mm**)' since otherwise you will have problems when printing or laser cutting your parts.
- Our lab has also printers, check with assistants for the use.
- **Hardware inventory** preferable check for components on RS Components (http://be02.rs-online.com/web/, delivered daily if in stock). Always ask approval from your advisors and discuss with them.
- **Fablab** The fablab will is at to the old police headquarters (U-square). This is a prototyping lab with free entrance. Check the opening hours for students. Their most important machines: Makerbot 3D printers 200*150*100mm, cnc-machining 2500*1500*100mm, PCB-mil A3-format, professional 3D printer 200*200*200mm. Lasercutter 60W 1100*800mm for MDF and Plexi. In case you use the machines for your thesis, you don't have to pay for the materials or usage of the machines. You have to however inform the responsible of the fact that you work for your thesis. Starting with one of the machines requires a tutorial which will be checked by the responsible.
- **Laser cutter** File extension required is .dxf. There are different ways to make .dxf files. One possibility with Autodesk Inventor: make an assembly .iam of your .ipt files. Next,

make an .idw file and import your assembly. Next, delete in the model tree (standard on the left) the 'default border' and 'ANSI – Large'. Next, expand the 'save as' menu, press 'save copy as' and chose .dxf. Make sure each new file you create is a file with mm as the standard unit and not inch.

# 4 Writing your thesis

Please ensure you check the official guidelines at bruface.be (for example concerning maximum number of pages etc.) and respect the deadline.

You can find inspiration for your writing (especially for your state of the art section) in papers published in journals or at conferences and Master of PhD dissertations. Google scholar is the most well-known tool for finding papers. We have a library of proceedings of the biggest international conferences (like ICRA and IROS) of the past years. Furthermore VUB has a subscription at IEEE. You can also log in to web of knowledge with your VUB account at http://www.vub.ac.be/BIBLIO/.

Writing your thesis is a very timeconsuming task and you should not underestimate it. Underneath are some hints to help you. Please read them carefully:

- **Back-ups** Most importantly: make sure you have enough back-ups. Typically one of the students' computers crashes after 5 years of studying. So please ensure you have back-ups on external drives and online backups (eg on onedrive).
- **Typesetting** Microsoft Word is the most well-known typesetting program. For thesis's and other scientific writing, many researchers prefer Latex (http://en.wikipedia.org/wiki/LaTeX). You can find many tutorials only on how to write in Latex and even on how to write a thesis in latex. Main difference is that Word is a WYSIWYG (What You See Is What You Get) program while with Latex your document is a text file and different fonts and citations are coded. It will take you a while to get started with Latex, but afterwards most people find it very convenient. A program that attempts to combine the best of both worlds is Lyx http://www.lyx.org/. A colleague from the electronics department wrote a tutorial and posted his source code online (http://student.vub.ac.be/~acooman/welcome.htm, section Lyx, in Dutch though).
- **Citations** It is very important to incorporate the most important papers in your state of the art section. Furthermore, in case you use a figure or content from another source (papers, dissertations, technical reports…) you are obliged to cite its source. Good software to organize your citations is Jabref or Qiqqa (both free). We advise you to start with this from the very beginning, after reading your first paper. You can manually enter the details for each paper, or use the option 'cite' after searching your paper with google scholar. You can then press 'import to bibtex', and copy this code into Jabref or Qiqqa. It helps if you write a small summary of the papers you read, right after reading them (you can do this in a Word file). This way when you start writing your state of the art chapter several months after reading all the papers you don't have to re-read them all, because you already summarized them. As citation style use IEEEtran (http://www.barik.net/sw/ieee/IEEEtran_bst_HOWTO.pdf).
- **Figures** To elucidate your work better you are advised to produce nice figures, graphs and schemes. It is very important to make high quality graphs in a good format. Preferably,

try to produce your figures with high resolution (600 DPI for example) and in a vector format (http://en.wikipedia.org/wiki/Vector_graphics ) (for example .pdf or .eps). Blurry figures in your thesis or presentation are unacceptable. Appropriate freeware to produce your figures is Paint.NET, Inkscape, GIMP 2, etc. Please refer in your text to your figures in a consistent format such as 'Fig. X' or 'Figure X'. Always refer to your figures with a direct reference like 'Fig. X' and not 'The figure above'. Same goes for your sections, never 'The next section' but 'Section X'. Figures need to be discussed in the dissertation, you have to guide the reader why the graph is relevant. Also make captions for figures self-explaining, highlighting the most relevant information what the reader has to see in the figure, the same applies for captions of graphs. Do not leave the analysis of the figure to the reader!

- **Graphs** Most probably you will produce graphs with Matlab or with Excel. It is strongly advised to save your figures in .fig/.xls format in addition to a .pdf or .eps format, since you will most probably have to alter details after a revision by your supervisor. It is highly important to define your axes (do not forget you units) and to make sure your axis details are in a font size which is readable. Many functions can be found for free on the matlab central http://www.mathworks.com/matlabcentral/. To export your figure as a .pdf the 'export_fig' function is an option (http://www.mathworks.com/matlabcentral/fileexchange/23629-exportfig).
- **Scientific writing** It is important to realize that writing your thesis is different from writing your diary. So please try to avoid writing in the first person and the use of slang language. Sentences like 'I did all the experiments on Monday but I had problems with the motor' are unacceptable. In scientific writing spoken abbreviations, e.g. don't, doesn't, and won't, are not accepted, write them in full: do not, does not, will not, etc.
- **Content table** The content table of your thesis is not fixed and might differ depending on your topic or personal preference. However, please use the following structure as a guideline: content table, acknowledgement, abstract, list of figures, list of tables, list of symbols, motivation, state of the art, goal, outline, chapter 1, chapter 2, chapter 3, …, conclusions and future work, bibliography, appendix. Please start every chapter with an introduction on what will be discussed in the different sections of that chapter.
- **Captions** Please ensure every figure has an appropriate caption. Avoid captions such as 'Speed with respect to time'. Instead, try to make captions that contain the general message you want to bring to your audience with the graph, e.g. 'The use of mechanism YxY clearly improved the overall speed distribution in the second half of the experiment'. In case you have subfigures in one figure, always name them 'A','B','C' and refer to them in your text with this name 'Fig. 1.A' and not 'The middle figure in figure 3'.
- **Abbreviations** You are of course allowed to use abbreviations in your text. The first time you use the abbreviation you should write out the whole word and put the abbreviation between brackets, e.g. '… Series Elastic Actuator (SEA). The SEA is …'. Do not forget your list of symbols/abbreviations as well. Avoid excessive use of abbreviations.
- **Spelling** Please ensure you do a spelling check before you send in a document for revision or submission. Do not tell us you will only do a full spelling check in the final document, regardless of how good you are at writing, you will still miss some mistakes in an 80 page document that cannot be found by the spelling checker. Tools as Grammarly exist today to assist you.

We offer every student the possibility to revise certain chapters or finished parts of their thesis. Simply contact your advisor(s) or supervisor(s) when you finished a certain part. However, to limit the time we have to spend on adding remarks and suggestions, we will only correct parts that are written according to the hints listed here above. Also avoid requesting a revision 2 days before the deadline.

# 5 Presentation

Please ensure you check the official guidelines at bruface.be (for example concerning the time limit etc.).

It is important to realize that your presentation is not an exact copy of your written document. Furthermore it is perfectly possible that certain parts of your work which required an extensive amount of time, will not or will only briefly be noticed in your presentation. To make a good presentation, you should first start by making a good story line on the content which you would like to transmit to the audience. When this is done, you can start collecting your graphs and figures and prepare your slides. Underneath you can find some hints to help you. Please read them carefully:

- **Slides** An indication for your number of slides is 1 slide per minute. This might alter (slightly) depending on your topic.
- **Structure** Ensure that your presentation is structured very well. Start with a clear introduction on what your topic is about and why it is relevant with a short state of the art. Next, clearly indicate your goals.
- **Figures** Since you will project your slides on a screen, it is crucial to have high quality figures. In case you produced your figures and graphs according to the guidelines in section 4, you will most probably be able to use/reformat these figures.
- **Animations** Communication can be seen as a signal with a message and noise. The key to a successful presentation is to avoid all kinds of noise. Therefore, try to avoid animations and very busy backgrounds since they will distract your audience.
- **Videos** Videos are a very nice way to present your work. However, be 100 % sure you added all videos in the same file as your presentation to avoid errors and be 100 % sure that the format of your video is compatible with your presentation software. Rehearsing your final presentation is a good way to find out if your videos work. Although, even if the videos work on your computer, does not mean they do on another one. Make sure you add the videos to the same folder as your presentation in case you want to open the presentation from a usb on another computer.
- **Exercise** We offer the possibility to have a try-out for the presentation in the days before the final presentation. However it is important that the presentation has been excercised already several times (especially make sure the 20min timing is respected).
- **Only VGA connector is foreseen when presented in ZW116, HDMI in library**, so pls bring adaptor if needed.

*As a last remark, we would like to advice you all to be proud of your results. In case you produced a prototype for example, take nice pictures with a white background and make a nice video and insert a link of this video to your abstract or introduction. This will drastically improve the overall impression of your jury. A finished thesis is the result of a year of hard work and if fruitful it will contain a lot of your contributions to a specific scientific field. Be proud of this and make it clear to anyone who reads your final document and/or sees your final presentation what your contributions are!*

*For any further questions you can contact your advisors.*

*Good luck!*