

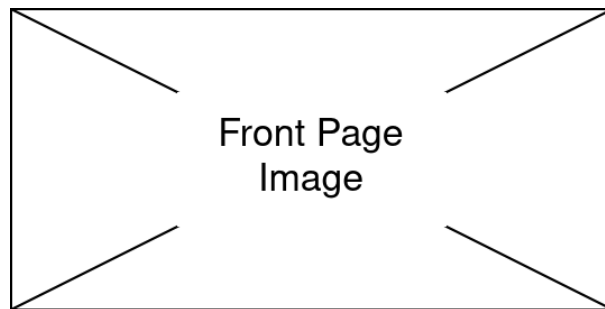
# Title

## Master Thesis

written by

**Name Surname**

example@mail.com



The code for this project is available at  
<https://some-github-url.com>

**Institution**

Faculty

Word Count : 17157

August 14, 2023

## **Abstract**

Writing abstracts is a skillful art that involves capturing the essence of a complex document, whether it's a research paper, article, or project, in a succinct and informative manner. An abstract serves as a concise summary that provides readers with a glimpse into the content and significance of the full work. An effective abstract typically includes a clear statement of the problem or purpose, a brief overview of the methodology or approach used, key findings or results, and their implications. It's important to strike a balance between conveying enough information to engage readers' interest and keeping the abstract concise. While avoiding unnecessary technical jargon, an abstract should accurately represent the main points of the work and encourage readers to delve deeper into the complete document for a comprehensive understanding.

# Contents

---

Acknowledgments . . . . .	ii
Acronyms and Terms . . . . .	iii
<b>1 Introduction</b>	<b>1</b>
1.1 Context . . . . .	1
1.2 Problem Description . . . . .	1
1.3 Thesis Overview . . . . .	1
<b>2 System Setup</b>	<b>2</b>
<b>3 State of the Art</b>	<b>3</b>
3.1 Problem 1 - Name of Problem 1 . . . . .	3
3.2 Problem 2 - Name of Problem 2 . . . . .	3
3.3 Problem 3 - Name of Problem 3 . . . . .	3
<b>4 Modeling</b>	<b>4</b>
<b>5 Name of Problem 1</b>	<b>5</b>
5.1 Methods . . . . .	5
5.2 Results . . . . .	5
5.3 Discussion & Conclusion . . . . .	5
<b>6 Name of Problem 2</b>	<b>6</b>
6.1 Methods . . . . .	6
6.2 Results . . . . .	6
6.3 Discussion & Conclusion . . . . .	6
<b>7 Problem 3</b>	<b>7</b>
7.1 Methods . . . . .	7
7.2 Results . . . . .	7
7.3 Discussion & Conclusion . . . . .	7
<b>8 Discussion &amp; Conclusion</b>	<b>8</b>
<b>A Appendix of Problem 1</b>	<b>10</b>
<b>B Appendix of Problem 2</b>	<b>11</b>
<b>C Appendix of Problem 3</b>	<b>12</b>

## **Acknowledgements**

Crafting an acknowledgement paragraph in a thesis is a heartfelt opportunity to express gratitude and recognition for the individuals and institutions that have contributed to the completion of the work. It's a chance to acknowledge the guidance, support, and inspiration received throughout the research journey. In this paragraph, one can extend appreciation to mentors, advisors, professors, and peers whose expertise and encouragement shaped the thesis. Personal gratitude to family and friends who provided emotional support during the challenging phases of research is also appropriate. Additionally, acknowledging funding sources, research facilities, and organizations that played a role in the project's success underscores the collaborative nature of academic pursuits. An acknowledgement paragraph, while concise, carries sincere sentiments that honor the shared effort and collaboration that culminated in the completion of the thesis.

## Acronyms

**cobots** collaborative robots.

**CP** correspondence problem.

**CV** computer vision.

**DL** deep learning.

**EE** end effector.

**PCR** point cloud registration.

**PE** pose estimation.

**ROS** Robot Operating System.

## Terms

**collaborative robots (cobots)** are robots which facilitate human-robot collaboration [1].

**computer vision (CV)** is a field of artificial intelligence (AI) that enables computers and systems to derive meaningful information from digital images, videos and other visual inputs - and take actions or make recommendations based on that information [2].

**correspondence problem (CP)** is the problem where one aims at finding correspondences between the pixels in two (or more) images [3].

**deep learning (DL)** are methods that allow computational models that are composed of multiple processing layers to learn representations of data with multiple levels of abstraction [4].

**end effector (EE)** is a generic term for all functional units involved in direct interaction of the robot system with the environment or with a given object [5].

**point cloud registration (PCR)** is a generic term for all functional units involved in direct interaction of the robot system with the environment or with a given object [5].

**pose estimation (PE)** A particular instance of feature-based alignment, which occurs very often, is estimating an object's 3D pose from a set of 2D point projections. This pose estimation problem is also known as extrinsic calibration [6].

**Robot Operating System (ROS)** is a set of open-source software libraries and tools that help build robot applications. [7].

## Chapter 1

# Introduction

---

### 1.1 Context

The contextual section within a thesis introduction serves as a bridge between the general knowledge of the field and the specific focus of your research. This section provides readers with essential background information that helps them understand the broader context within which your study operates. To write an effective contextual section, begin by outlining the foundational concepts, theories, and existing research relevant to your topic. Highlight key developments, debates, and gaps in the literature that your research aims to address. You can also mention any real-world implications or applications of your work. By carefully weaving together the established knowledge in the field and your research's niche, the contextual section sets the stage for the reader, preparing them to appreciate the significance and uniqueness of your study. Balancing conciseness with clarity, the section should smoothly transition from the general to the specific, ensuring that your research's importance is clearly conveyed within the broader academic landscape.

### 1.2 Problem Description

Writing a problem description in a thesis involves articulating the central challenge or question that your research aims to address. It is a critical section that sets the context for your work, highlighting its significance and relevance. To effectively write a problem description, start by clearly defining the problem, outlining its scope, and emphasizing its real-world implications. Provide background information to help readers understand the context and the gaps in existing knowledge or practices that your research seeks to fill. Use clear and concise language to convey the problem's complexity while avoiding unnecessary jargon. Consider incorporating relevant statistics, anecdotes, or examples to illustrate the problem's impact. Additionally, acknowledge existing research and solutions related to the problem, emphasizing the unique perspective or approach your study brings. Ultimately, a well-crafted problem description should engage readers' interest and lay the foundation for the subsequent sections of your thesis.

The problem can ideally be decomposed into some number of sub-problems, that here can be presented. These can later have their own chapters, literature review etc.

### 1.3 Thesis Overview

Composing a thesis overview is a foundational step in guiding readers through the content and scope of your research. This succinct yet informative section serves as a roadmap, providing readers with a clear understanding of the purpose, structure, and key elements of your thesis. Begin by introducing the broader research topic and its significance, highlighting the gap in existing knowledge or the problem you aim to address. Subsequently, briefly outline the main research questions, hypotheses, or objectives that your thesis seeks to answer or achieve. Mention the methodology or approach you adopted and provide a glimpse of the primary findings or outcomes. Additionally, touch upon the organization of the subsequent chapters, delineating how each chapter contributes to the overall narrative. The overview should strike a balance between providing enough context for readers to engage with your work and maintaining conciseness to maintain their interest. In essence, a well-crafted thesis overview offers a panoramic view of your research journey, setting the stage for a coherent and engaging exploration of your thesis.

## Chapter 2

# System Setup

---

Writing a comprehensive system setup section in an engineering thesis is pivotal for providing readers with a clear understanding of the technical infrastructure and experimental setup employed in your research. This section acts as a roadmap, guiding readers through the essential components and configurations of the system. Begin by detailing the hardware and software components, including specific models, versions, and specifications, as these are crucial for reproducibility. Explain the rationale behind your choices and how they align with your research objectives. Diagrams, flowcharts, and illustrations can greatly enhance comprehension. Address any calibration procedures, safety measures, or environmental conditions that impact the system's functionality. Additionally, highlight any customizations or modifications made to existing systems. A well-written system setup not only demonstrates your mastery of the technical aspects but also lays the foundation for readers to grasp the context and validity of your experimental results.

Make sure to make it clear what parts are provided and what are developed. This holds for both software and hardware. A graph or some data to demonstrate the provided systems validity can be used with benefit.

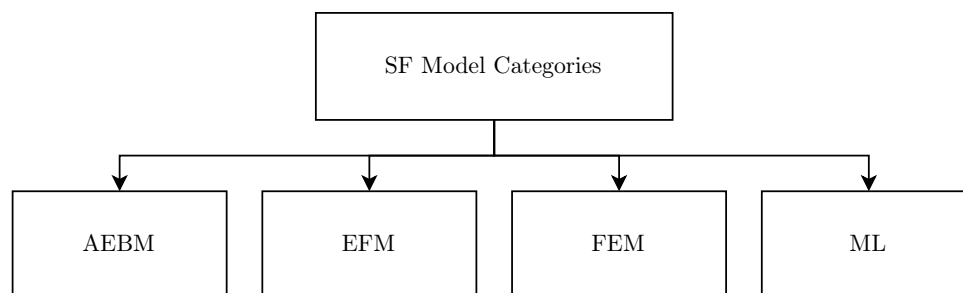
## Chapter 3

# State of the Art

---

Crafting a comprehensive literature review in an engineering thesis is a meticulous process that involves critically analyzing existing research to contextualize your work within the broader scientific landscape. Start by defining the scope and objectives of your literature review, outlining the key research questions or themes you aim to address. Systematically search and identify relevant peer-reviewed articles, conference papers, and reputable sources related to your topic. As you delve into each source, synthesize the information by identifying common trends, conflicts, gaps, and methodologies used in the field. Organize your review thematically, chronologically, or by grouping similar studies, ensuring a coherent flow of ideas. It's essential to critically evaluate the quality and relevance of each source and discuss their contributions to the field. Through your literature review, you not only showcase your understanding of existing knowledge but also lay the foundation for your engineering thesis by identifying opportunities for innovation and delineating the path forward for your research.

If these become of significant complexity, overview figures can be applied with great benefit, such as the one shown in Fig. 3.1



**Fig. 3.1:** Example of sub-category tree.

### 3.1 Problem 1 - Name of Problem 1

literature review of problem 1.

### 3.2 Problem 2 - Name of Problem 2

literature review of problem 2.

### 3.3 Problem 3 - Name of Problem 3

literature review of problem 3.

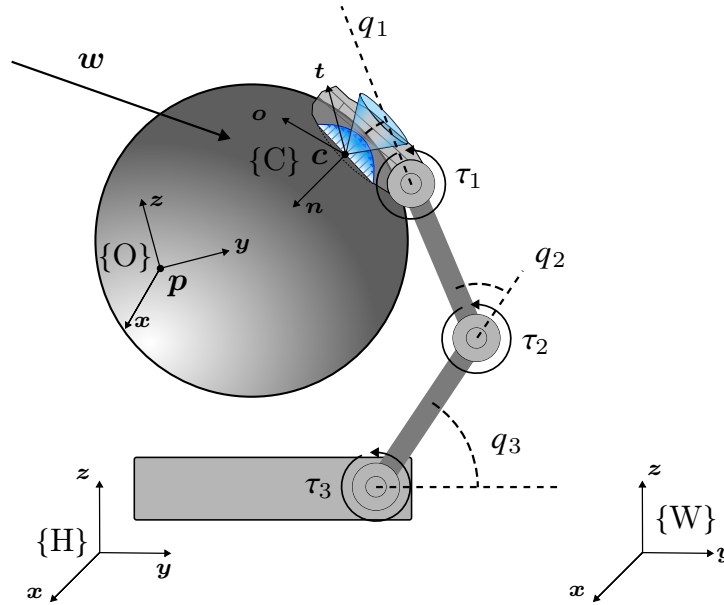


## Chapter 4

# Modeling

Writing a modeling chapter in an engineering thesis involves a structured and comprehensive approach to presenting the conceptualization, design, and analysis of the model. This chapter serves as a bridge between theoretical understanding and practical application, showcasing the technical prowess of the researcher. Begin by clearly defining the purpose and scope of the model, outlining the problem it addresses, and highlighting its significance in the context of the broader field. Detail the assumptions and simplifications made during model development, discussing the underlying mathematical equations, physical principles, or algorithms employed. Offer clarity on the model's inputs, parameters, and variables, providing justifications for their selection. Present the model's design process step-by-step, including numerical methods or software tools used for simulations. Visual aids, such as graphs, diagrams, and schematics, can enhance clarity and comprehension. Discuss validation efforts by comparing model predictions with experimental or empirical data. Address the limitations and uncertainties associated with the model, highlighting areas for future refinement. Concluding with a summary of key findings and their implications solidifies the chapter's role in contributing to the understanding of complex engineering phenomena.

Here illustrations can be helpful as the one shown in Fig. 4.1.



**Fig. 4.1:** example system illustration.

## Chapter 5

# Name of Problem 1

---

Problem 1 introduction.

### **5.1 Methods**

The methods used to solve problem 1.

### **5.2 Results**

The results gained from solving problem 1.

### **5.3 Discussion & Conclusion**

A discussion and conclusion of the results found in solving problem 1.

## Chapter 6

# Name of Problem 2

---

Problem 2 introduction.

### **6.1 Methods**

The methods used to solve problem 2.

### **6.2 Results**

The results gained from solving problem 2.

### **6.3 Discussion & Conclusion**

A discussion and conclusion of the results found in solving problem 2.

## Chapter 7

# Problem 3

---

Problem 3 introduction.

### 7.1 Methods

The methods used to solve problem 3.

### 7.2 Results

The results gained from solving problem 3.

### 7.3 Discussion & Conclusion

A discussion and conclusion of the results found in solving problem 3.

## Chapter 8

# Discussion & Conclusion

---

Composing the discussion and conclusion chapters of an engineering thesis requires a comprehensive synthesis of the research findings and their broader implications. In the discussion chapter, delve into the results, critically analyzing them within the context of the research objectives and hypotheses. Highlight patterns, trends, and deviations, offering possible explanations supported by literature. Address any limitations or uncertainties and explore potential avenues for future research. Transitioning to the conclusion chapter, recap the main contributions of the study, reaffirming how they align with the initial research questions. Summarize the significance of the findings in the broader field of engineering and their real-world applications. A strong conclusion should reflect on the relevance of the research and its potential impact on the industry or society. Emphasize the implications of the study's outcomes, showcasing how they fill gaps in knowledge, address challenges, or advance technology. Ultimately, these chapters serve as a platform to demonstrate your grasp of the subject matter, your ability to critically evaluate outcomes, and your aptitude for drawing valuable insights from complex data, all of which underpin the holistic contribution of your engineering thesis to the field.

# Bibliography

---

- [1] El Zaatari, Shirine et al. “Cobot programming for collaborative industrial tasks: An overview”. In: *Robotics and Autonomous Systems* 116 (June 2019), pp. 162–180. DOI: 10.1016/j.robot.2019.03.003.
- [2] *What is computer vision?* <https://www.ibm.com/topics/computer-vision>. Accessed: 2022-11-02.
- [3] Zimmer, Henning. “Correspondence problems in computer vision”. PhD thesis. Jan. 2012.
- [4] LeCun, Yann, Bengio, Yoshua, and Hinton, Geoffrey. “Deep learning”. In: *Nature* 521.7553 (May 2015), pp. 436–444. ISSN: 1476-4687. DOI: 10.1038/nature14539. URL: <https://doi.org/10.1038/nature14539>.
- [5] Monkman, Gareth J. et al. “Robot Grippers”. PhD thesis. Jan. 2004, pp. 5–6.
- [6] Szeliski, Richard. *Computer vision: algorithms and applications*. Springer Nature, 2022, p. 284.
- [7] Quigley, Morgan et al. “ROS: an open-source Robot Operating System”. In: *ICRA Workshop on Open Source Software* 3 (Jan. 2009).

Appendix A

## **Appendix of Problem 1**

---

Appendix B

## **Appendix of Problem 2**

---



Appendix C

## **Appendix of Problem 3**

---