Modbus Based Smart Energy Tracking and Control System

Subtitle if needed

KON 4902 Control & Automation Engineering Design II

Final Report

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Submitted in fulfillment of requirements for the degree of
Bachelor of Science in Control & **Automation Engineering**

Department of Control and Automation Engineering
Istanbul Technical University
2025

The following text is only an example. Write your dedication sentence(s) here.

"...to my loved ones...."

"The supreme guide in life is knowledge."

Mustafa Kemal Atatürk, 19∞

"At times, our own light goes out and is rekindled by a spark from another person. Each of us has cause to think with deep gratitude of those who have lighted the flame within us."

Albert Schweitzer, 19XX

"Feeling gratitude and not expressing it is like wrapping a present and not giving it."

William Arthur Ward, 19XX

".....an empty text..... "

The Author Name Surname, 2025

Abstract

The following text is only an example. Prepare according to your project/study.

The abstract is a very brief summary of the dissertation's contents. It should be about a page long. Somebody unfamiliar with your project should have a good idea of what it's about having read the abstract alone and will know whether it will be of interest to them. You may write a paragraph about where and when the project is carried out and under which motivation. This report summarizes the work carried out within A Company / A Laboratory, which consists of designing and implementing ....

You should add one or more paragraphs about the objectives and main findings of your work. Give specific concentration on which engineering criteria you have addressed, what kind of boundary conditions you have considered, and what kind of engineering standards you have considered. You do not need to give details at this point but may mention that the details are given in your report.

You should add one or more paragraphs about the objectives and main findings of your work. Give specific concentration on which engineering criteria you have addressed, what kind of boundary conditions you have considered, and what kind of engineering standards you have considered. You do not need to give details at this point but may mention that the details are given in your report.

You should add one or more paragraphs about the objectives and main findings of your work. Give specific concentration on which engineering criteria you have addressed, what kind of boundary conditions you have considered, and what kind of engineering standards you have considered. You do not need to give details at this point but may mention that the details are given in your report.

Keywords : artificial intelligence, deep learning, fail-safe design, low-order controller design, optimization, railway systems, robust control.(seperate with commas ","(minimum 3, maximum 7 words)(keywords should be in alphabetical order).

Abstract in Turkish(Özet)

The following text is only an example. Prepare according to your project/study.

Özet, tezin içeriğinin çok kısa bir özetidir. Yaklaşık bir sayfa uzunluğunda olmalıdır. Projeniz hakkında bilgi sahibi olmayan bir kişi, yalnızca özeti okuyarak çalışmanızın ne hakkında olduğunu anlamalı ve kendisi için ilgi çekici olup olmadığını belirleyebilmelidir. Projenin nerede ve ne zaman gerçekleştirildiğini ve hangi motivasyonla yürütüldüğünü belirten bir paragraf yazabilirsiniz. Bu rapor, A Şirketi / A Laboratuvarı bünyesinde yürütülen, tasarım ve uygulama süreçlerini içeren çalışmaları özetlemektedir.

Çalışmanızın hedefleri ve ana bulguları hakkında bir veya daha fazla paragraf eklemelisiniz. Özellikle ele aldığınız mühendislik kriterlerine, dikkate aldığınız sınır koşullarına ve göz önünde bulundurduğunuz mühendislik standartlarına odaklanın. Bu aşamada ayrıntılara girmeye gerek yoktur, ancak detayların raporunuzda yer aldığını belirtebilirsiniz.

Çalışmanızın hedefleri ve ana bulguları hakkında bir veya daha fazla paragraf eklemelisiniz. Özellikle ele aldığınız mühendislik kriterlerine, dikkate aldığınız sınır koşullarına ve göz önünde bulundurduğunuz mühendislik standartlarına odaklanın. Bu aşamada ayrıntılara girmeye gerek yoktur, ancak detayların raporunuzda yer aldığını belirtebilirsiniz.

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Anahtar Kelimeler : dayanıklı control, derin öğrenme, düşük mertebeli kontrolör tasarımı, en iyileme, hatada emniyetli tasarım, raylı sistemler, yapay zeka.(seperate with commas ","(minimum 3, maximum 7 words)(keywords should be in alphabetical order).

Declaration of Originality

We, the undersigned students, declare that this report was entirely prepared through our own efforts and work. All sections of the report that rely on external sources have been explicitly stated and properly cited.

During the preparation of the report, AI tools were used solely for supporting tasks such as grammar corrections, writing adjustments, and formatting. No AI tools or external sources were used for content generation in any part of the report.

For projects involving teamwork, we confirm that the contribution percentages specified in the Individual Contribution Statement section at the end of the report are accurate and that all team members contributed to the project in alignment with these percentages.

The checklist accompanying this report has been accurately and completely filled out in accordance with the relevant instructions.

Signatures:

Name and Surname	**Student ID**	**Date**	**Signature**
[Name Surname]	[ID]		
[Name Surname]	[ID]		
[Name Surname]	[ID]		
[Name Surname]	[ID]		
[Name Surname]	[ID]		

Copyright Declaration

The following text is only an example. Prepare according to your project/study.

Acknowledgments

The following text is only an example. Prepare according to your project/study.

It is usual to thank those individuals who have provided particularly useful assistance, technical or otherwise, during your project.

This is not needed, but common.

Contents

List of Acronyms

The following text is only an example. Prepare according to your project/study.

CAE Control and Automation Engineering

EEE Electrical and Electronics Engineering

ITU Istanbul Technical University

IEEE Institution of Electrical and Electronics Engineers

IFAC International Federation of Automatic Control

TOK Turkish Automatic Control National Committee

LTI Linear time-invariant

PID Proportional Integral Derivative

List of Symbols

The following text is only an example. Prepare according to your project/study.

$+$	Addition Operator	
$-$	Subtraction Operator	
$\times$	Multiplication Operator	
$\sqrt{x}$	Square Root of x	
$\odot$	Foo Bar	
$\Leftrightarrow$	Bar Foo	
α	Alpha	
β	Beta	
a	distance	m
P	power	W ($\mathrm{J\,s^{-1}}$)
ω	angular frequency	rad

List of Figures

List of Tables

1 Introduction

Contents

Motivation

The following text is only an example to emphasize significant points. Prepare according to your project/study.

- **Background and Context**
  - Overview of the problem domain
  - Importance of the topic in current research and industry
  - Real-world applications and relevance
- **Problem Identification**
  - Key challenges in the field
  - Existing limitations and gaps in current solutions
  - Need for improvement or innovation
- **Significance of the Project**

1

  - Expected contributions to the field
  - Potential impact on academia, industry, or society
  - Alignment with modern technological advancements

- **Personal and Academic Motivation**
  - Relevance to the students' academic background and interests
  - Career aspirations and future research opportunities
  - Connection with previous coursework and skills development

Design Criteria

The following text is only an example to emphasize significant points. Prepare according to your project/study.

- **Performance Requirements**
  - Desired accuracy, speed, or efficiency of the system
  - Response time and stability considerations
  - Error tolerance and robustness
- **Technical Specifications**
  - Hardware and software requirements
  - System architecture (e.g., microcontroller, sensors, actuators, algorithms)
  - Communication protocols (if applicable)
- **Feasibility and Constraints**
  - Cost limitations
  - Power consumption and efficiency
  - Manufacturing or implementation feasibility
- **Scalability and Flexibility**
  - Potential for future upgrades or modifications
  - Adaptability to different environments or use cases
- **Safety and Reliability**
  - Compliance with safety standards

  - Fault tolerance and redundancy
  - Testing and validation procedures

- **Usability and Human Interaction**
  - User interface and experience (if applicable)
  - Ease of use and accessibility

- **Environmental and Sustainability Considerations**
  - Energy efficiency and material selection
  - Environmental impact and recyclability

Literature Review

The following text is only an example to emphasize significant points. Prepare according to your project/study. Main points/subheadings are given below

- Previous Work
- Related Studies
- Research Gap

Contribution of the Study

The following text is only an example to emphasize significant points. Prepare according to your project/study. Main points/subheadings are given below

- **Scientific Contributions**
  - Introduction of new methodologies, models, or algorithms
  - Enhancement or improvement of existing techniques
  - Validation of theoretical concepts through experiments or simulations

- **Technical Contributions**
  - Development of software, hardware, or computational tools
  - Implementation of innovative solutions for real-world applications
  - Performance improvements in terms of accuracy, efficiency, or robustness

- **Practical and Industrial Contributions**

  - Applications in industry, automation, or emerging technologies
  - Potential commercialization or technology transfer opportunities
  - Enhancement of processes in engineering and applied sciences

- **Academic and Educational Contributions**
  - Supporting future research in related fields
  - Providing datasets, open-source code, or experimental benchmarks
  - Enhancing student learning and academic projects

- **Societal and Environmental Contributions**
  - Solutions addressing sustainability and environmental impact
  - Contribution to public safety, healthcare, or smart technologies
  - Alignment with ethical and responsible engineering practices

Structure of the Report

The following text is only an example to demonstrate a possible structure to be used in this subsection. Prepare according to your project/study.

This report is organized into several chapters, each covering different aspects of the study. A brief outline of each chapter is provided below:

- **Chapter 1: Introduction**
  - Provides background information and motivation for the study.
  - Defines the research problem and objectives.
  - Summarizes the structure of the thesis.

- **Chapter 2: Literature Review**
  - Reviews existing research and related works in the field.
  - Identifies gaps and limitations in previous studies.
  - Justifies the need for the proposed approach.

- **Chapter 3: Methodology**
  - Describes the theoretical foundations and mathematical models.
  - Explains the proposed method, framework, or system design.

  - Details the tools, software, and experimental setup used.

- **Chapter 4: Implementation**
  - Discusses the practical realization of the proposed method.
  - Provides details on system architecture, hardware/software implementation.
  - Highlights challenges and how they were addressed.

- **Chapter 5: Results and Discussion**
  - Presents experimental results, data analysis, and performance evaluation.
  - Compares results with existing approaches.
  - Discusses key findings and their implications.

- **Chapter 6: Conclusion and Future Work**
  - Summarizes the main contributions of the study.
  - Discusses the limitations of the work.
  - Suggests possible directions for future research and improvements.

1

2

Literature Review

Contents

The following texts are random and meaningless. Prepare according to your project/study by considering the following subtopics.

- Review existing research and related works in the field.
- Identify gaps and limitations in previous studies.
- Justify the need for the proposed approach.

Review existing research and related works in the field

As any dedicated reader can clearly see, the Ideal of practical reason is a representation of, as far as I know, the things in themselves; as I have shown elsewhere, the phenomena should only be used as a canon for our understanding. The paralogisms of practical reason are what first give rise to the architectonic of practical reason. As will easily be shown in the next section, reason would thereby be made to contradict, in view of these considerations, the Ideal of practical reason, yet the manifold depends on the phenomena. Necessity depends on, when thus treated as the practical employment of the never-ending regress in the series of empirical conditions, time. Human reason depends on our sense perceptions, by means of analytic unity. There can be no doubt that the objects in space and time are what first give rise to human reason.

Identify gaps and limitations in previous studies

2

As any dedicated reader can clearly see, the Ideal of practical reason is a representation of, as far as I know, the things in themselves; as I have shown elsewhere, the phenomena should only be used as a canon for our understanding. The paralogisms of practical reason are what first give rise to the architectonic of practical reason. As will easily be shown in the next section, reason would thereby be made to contradict, in view of these considerations, the Ideal of practical reason, yet the manifold depends on the phenomena. Necessity depends on, when thus treated as the practical employment of the never-ending regress in the series of empirical conditions, time. Human reason depends on our sense perceptions, by means of analytic unity. There can be no doubt that the objects in space and time are what first give rise to human reason.

Justify the need for the proposed approach

As any dedicated reader can clearly see, the Ideal of practical reason is a representation of, as far as I know, the things in themselves; as I have shown elsewhere, the phenomena should only be used as a canon for our understanding. The paralogisms of practical reason are what first give rise to the architectonic of practical reason. As will easily be shown in the next section, reason would thereby be made to contradict, in view of these considerations, the Ideal of practical reason, yet the manifold depends on the phenomena. Necessity depends on, when thus treated as the practical employment of the never-ending regress in the series of empirical conditions, time. Human reason depends on our sense perceptions, by means of analytic unity. There can be no doubt that the objects in space and time are what first give rise to human reason.

3 Methodology

Contents

The following texts are random and meaningless. Prepare according to your project/study by considering the following subtopics.

- Describes the theoretical foundations and mathematical models.
- Explains the proposed method, framework, or system design.
- Details the tools, software, and experimental setup used.

Describe the theoretical foundations and mathematical models

As any dedicated reader can clearly see, the Ideal of practical reason is a representation of, as far as I know, the things in themselves; as I have shown elsewhere, the phenomena should only be used as a canon for our understanding. The paralogisms of practical reason are what first give rise to the architectonic of practical reason. As will easily be shown in the next section, reason would thereby be made to contradict, in view of these considerations, the Ideal of practical reason, yet the manifold depends on the phenomena. Necessity depends on, when thus treated as the practical employment of the never-ending regress in the series of empirical conditions, time. Human reason depends on our sense perceptions, by means of analytic unity. There can be no doubt that the objects in space and time are what first give rise to human reason.

3

Explain the proposed method, framework, or system design

As any dedicated reader can clearly see, the Ideal of practical reason is a representation of, as far as I know, the things in themselves; as I have shown elsewhere, the phenomena should only be used as a canon for our understanding. The paralogisms of practical reason are what first give rise to the architectonic of practical reason. As will easily be shown in the next section, reason would thereby be made to contradict, in view of these considerations, the Ideal of practical reason, yet the manifold depends on the phenomena. Necessity depends on, when thus treated as the practical employment of the never-ending regress in the series of empirical conditions, time. Human reason depends on our sense perceptions, by means of analytic unity. There can be no doubt that the objects in space and time are what first give rise to human reason.

Detail the tools, software, and experimental setup used

As any dedicated reader can clearly see, the Ideal of practical reason is a representation of, as far as I know, the things in themselves; as I have shown elsewhere, the phenomena should only be used as a canon for our understanding. The paralogisms of practical reason are what first give rise to the architectonic of practical reason. As will easily be shown in the next section, reason would thereby be made to contradict, in view of these considerations, the Ideal of practical reason, yet the manifold depends on the phenomena. Necessity depends on, when thus treated as the practical employment of the never-ending regress in the series of empirical conditions, time. Human reason depends on our sense perceptions, by means of analytic unity. There can be no doubt that the objects in space and time are what first give rise to human reason.

4 Implementation

Contents

The following texts are random and meaningless. Prepare according to your project/study by considering the following subtopics.

- Discuss the practical realization of the proposed method.
- Provide details on system architecture, hardware/software implementation.
- Highlight challenges and how they were addressed.

Discuss the practical realization of the proposed method

As any dedicated reader can clearly see, the Ideal of practical reason is a representation of, as far as I know, the things in themselves; as I have shown elsewhere, the phenomena should only be used as a canon for our understanding. The paralogisms of practical reason are what first give rise to the architectonic of practical reason. As will easily be shown in the next section, reason would thereby be made to contradict, in view of these considerations, the Ideal of practical reason, yet the manifold depends on the phenomena. Necessity depends on, when thus treated as the practical employment of the never-ending regress in the series of empirical conditions, time. Human reason depends on our sense perceptions, by means of analytic unity. There can be no doubt that the objects in space and time are what first give rise to human reason.

4

Provide details on system architecture, hardware/software implementation

As any dedicated reader can clearly see, the Ideal of practical reason is a representation of, as far as I know, the things in themselves; as I have shown elsewhere, the phenomena should only be used as a canon for our understanding. The paralogisms of practical reason are what first give rise to the architectonic of practical reason. As will easily be shown in the next section, reason would thereby be made to contradict, in view of these considerations, the Ideal of practical reason, yet the manifold depends on the phenomena. Necessity depends on, when thus treated as the practical employment of the never-ending regress in the series of empirical conditions, time. Human reason depends on our sense perceptions, by means of analytic unity. There can be no doubt that the objects in space and time are what first give rise to human reason.

Highlight challenges and how they were addressed

As any dedicated reader can clearly see, the Ideal of practical reason is a representation of, as far as I know, the things in themselves; as I have shown elsewhere, the phenomena should only be used as a canon for our understanding. The paralogisms of practical reason are what first give rise to the architectonic of practical reason. As will easily be shown in the next section, reason would thereby be made to contradict, in view of these considerations, the Ideal of practical reason, yet the manifold depends on the phenomena. Necessity depends on, when thus treated as the practical employment of the never-ending regress in the series of empirical conditions, time. Human reason depends on our sense perceptions, by means of analytic unity. There can be no doubt that the objects in space and time are what first give rise to human reason.

5

Simulations, Results and Discussion

Contents

The following texts are random and meaningless. Prepare according to your project/study by considering the following subtopics.

- Present experimental results, data analysis, and performance evaluation.
- Compare results with existing approaches.
- Discuss key findings and their implications.

Present experimental results, data analysis, and performance evaluation

As any dedicated reader can clearly see, the Ideal of practical reason is a representation of, as far as I know, the things in themselves; as I have shown elsewhere, the phenomena should only be used as a canon for our understanding. The paralogisms of practical reason are what first give rise to the architectonic of practical reason. As will easily be shown in the next section, reason would thereby be made to contradict, in view of these considerations, the Ideal of practical reason, yet the manifold depends on the phenomena. Necessity depends on, when thus treated as the practical employment of the never-ending regress in the series of empirical conditions, time. Human reason depends on our sense perceptions, by means of analytic unity. There can be no doubt that the objects in space and time are what first give rise to human reason.

Compare results with existing approaches

As any dedicated reader can clearly see, the Ideal of practical reason is a representation of, as far as I know, the things in themselves; as I have shown elsewhere, the phenomena should only be used as a canon for our understanding. The paralogisms of practical reason are what first give rise to the architectonic of practical reason. As will easily be shown in the next section, reason would thereby be made to contradict, in view of these considerations, the Ideal of practical reason, yet the manifold depends on the phenomena. Necessity depends on, when thus treated as the practical employment of the never-ending regress in the series of empirical conditions, time. Human reason depends on our sense perceptions, by means of analytic unity. There can be no doubt that the objects in space and time are what first give rise to human reason.

Discuss key findings and their implications

As any dedicated reader can clearly see, the Ideal of practical reason is a representation of, as far as I know, the things in themselves; as I have shown elsewhere, the phenomena should only be used as a canon for our understanding. The paralogisms of practical reason are what first give rise to the architectonic of practical reason. As will easily be shown in the next section, reason would thereby be made to contradict, in view of these considerations, the Ideal of practical reason, yet the manifold depends on the phenomena. Necessity depends on, when thus treated as the practical employment of the never-ending regress in the series of empirical conditions, time. Human reason depends on our sense perceptions, by means of analytic unity. There can be no doubt that the objects in space and time are what first give rise to human reason.

6

Conclusion and Future Work

All good projects conclude with an objective evaluation of the project's successes and failures and suggestions for future work that can take the project further. It is important to understand that there is no such thing as a perfect project.

Even the very best pieces of work have their limitations and you are expected to provide a proper critical appraisal of what you have done. Your assessors are bound to spot the limitations of your work and you are expected to be able to do the same.

The above texts are random and meaningless. Prepare according to your project/study by considering the following subtopics.

- Summarize the main contributions of the study.
- Discuss the limitations of the work.
- Suggest possible directions for future research and improvements.

6

Ethical Rules Compliance Statement

I recognize and accept the basic principles of engineering which stated below.

Name and Surname	Student ID	Date	Signature
[Name Surname]	[ID]		
[Name Surname]	[ID]		
[Name Surname]	[ID]		
[Name Surname]	[ID]		
[Name Surname]	[ID]		

Engineers; they glorify and develop the integrity, honor and value of the engineering profession by using their own knowledge and skills to increase the welfare of humanity, by serving honestly and impartially to the public, their employers and customers, by striving to increase the ability and prestige of the engineering profession, by supporting the professional and technical unity of their disciplines.

- Engineers will prioritize the safety, health and comfort of the society while performing their professional duties.
- Engineers will only provide service in areas where they are authorized.
- Engineers will only issue objective and realistic reports.
- Engineers will act as reliable attorneys or assistants to the employer or client in professional matters and avoid conflicts of interest.
- Engineers will establish their professional reputation according to the requirements of their services and will not enter into unfair competition with other colleagues.
- Engineers will work to promote and develop integrity, honor and value of profession.
- Engineers will continue their professional development through their own careers and will provide opportunities for the professional development of engineers under their control.

I declare that the parst quoted from any source in this report are less than 15%, and the number of one-to-one quotations in paragraphs is zero.

Name and Surname	**Student ID**	**Date**	**Signature**
[Name Surname]	[ID]		
[Name Surname]	[ID]		
[Name Surname]	[ID]		
[Name Surname]	[ID]		
[Name Surname]	[ID]		

IEEE Code of Ethics

IEEE CODE OF ETHICS: It will be added to the report as it is.

We, the members of the IEEE, in recognition of the importance of our technologies in affecting the quality of life throughout the world, and in accepting a personal obligation to our profession, its members and the communities we serve, do hereby commit ourselves to the highest ethical and professional conduct and agree:

1. to accept responsibility in making engineering decisions consistent with the safety, health and welfare of the public, and to disclose promptly factors that might endanger the public or the environment;
2. to avoid real or perceived conflicts of interest whenever possible, and to disclose them to affected parties when they do exist;
3. to be honest and realistic in stating claims or estimates based on available data;
4. to reject bribery in all its forms;
5. to improve the understanding of technology, its appropriate application, and potential consequences;
6. to maintain and improve our technical competence and to undertake technological tasks for others only if qualified by training or experience, or after full disclosure of pertinent limitations;
7. to seek, accept, and offer honest criticism of technical work, to acknowledge and correct errors, and to credit properly the contributions of others;
8. to treat fairly all persons regardless of such factors as race, religion, gender, disability, age, or national origin;
9. to avoid injuring others, their property, reputation, or employment by false or malicious action;
10. to assist colleagues and co-workers in their professional development and to support them in following this code of ethics.

Approved by the IEEE Board of Directors

August 1990

Individual Contribution Statement

This Interim Report/Graduation Project is the result of a collaborative research effort by [**Team Name or Project Group**], consisting of [**List of Student Names**]. While the research was conducted as a team, each member contributed distinctively to different aspects of the study.

My Contributions

My specific contributions to this dissertation include:

- Conducting a comprehensive literature review and identifying research gaps.
- Developing the theoretical framework and mathematical modeling approach.
- Implementing the computational simulations and analyzing the results.
- Writing and revising specific sections of the dissertation, particularly [**mention sections**].

Team Contributions

Other team members contributed in the following ways:

- [**Student Name 1**]: Focused on data collection, experimental setup, and initial analysis.
- [**Student Name 2**]: Developed the software implementation and optimization algorithms.
- [**Student Name 3**]: Conducted statistical analysis and validated the experimental findings.

Throughout the research process, we collaborated closely, exchanging ideas, refining methodologies, and integrating our findings into a cohesive study. While responsibilities were divided, all major decisions were made collectively, ensuring the integrity and coherence of the final dissertation.

Signatures

We confirm that the contributions described above accurately represent our role in this research.

Name and Surname	**Student ID**	**Date**	**Signature**
[Name Surname]	[ID]		
[Name Surname]	[ID]		
[Name Surname]	[ID]		
[Name Surname]	[ID]		
[Name Surname]	[ID]		

Constraints and Engineering Standards Used in the Report

As undergraduate students in engineering, you are constantly learning how to design, analyze, and build systems that solve real-world problems. But have you ever wondered what makes a design truly successful? It's not just about creativity or technical skills—it's also about adhering to multiple design constraints and engineering standards. These two concepts are the backbone of any accredited engineering program and are critical to your development as a professional engineer.

In accordance with the accreditation rules for the program, each and every major design project must incorporate appropriate engineering standards and multiple constraints. Therefore you must give specific importance to this section. You must clearly state what kind of constraints (**must be more than one**) are considered in your project and which boundary conditions are used to test the validity of your design. You must also provide a detailed list of engineering standards used and explain their relevance to your work. **You must ald discuss how these constraints and standards have impacted your engineering design. If you do not comply with these requirements, your project will be considered invalid, and you may need to retake the course**.

Constraints Used in the Report

The following text is only an example to emphasize significant points. Note: Don't forget to change the text.

Write this section very carefully, referring very clearly to the design section in the introduction and/or the different sections required, according to your design criteria.

Design criteria are the specific requirements that a project must meet to be considered successful. These criteria often include factors like functionality, cost, safety, sustainability, and aesthetics. However, relying on just one criterion is not enough. Engineering projects are complex, and they must balance competing priorities. For example:

A control system for an industrial robot must be precise (performance) but also energy-efficient (economics) and robust against disturbances (reliability).

An autonomous vehicle control system must be accurate (safety) but also computationally efficient (real-time performance) and adaptable to different environments (flexibility).

Using multiple design criteria ensures that your project is well-rounded and meets the needs of all stakeholders, including clients, users, and regulatory bodies. It also prepares you to think critically and make informed trade-offs, which is a key skill in engineering.

Discuss how the constraints you mention impacted your engineering design.

Engineering Standards Used in the Report

Write down the engineering standards that are actually relevant to your work and clearly state where, how, why, for what purpose, etc. they are used, by referencing the relevant sections in your thesis.

Engineering standards are established guidelines, codes, and best practices that ensure consistency, safety, and quality in engineering work. These standards are developed by professional organizations (like IEEE, ASME, or ISO) and are often legally required. For example:

Functional safety standards (such as IEC 61508) ensure that industrial automation systems operate safely and minimize risks.

Communication protocols (such as IEC 61158 for industrial networks) ensure interoperability between automation devices.

Electromagnetic compatibility (EMC) standards prevent control systems from interfering with other electronic devices.

By following engineering standards, you ensure that your designs are not only innovative but also safe, reliable, and compliant with legal requirements. This is especially important for accreditation, as programs must demonstrate that their graduates can apply these standards in real-world scenarios.

Discuss how the standards you mention impacted your engineering design.

STANDARDS AND CONSTRAINTS FORM

1. What is the design aspect of your project? Explain.

Is it a new project or repetition of an existing project? Is it a part of another project?

2. Briefly explain what the engineering problem that you have solved in your project and what is your solution on this problem.

3. Which knowledge you have learnt and which experiences you have gained throughout your university education, have you used when preparing your project?

Which lectures were useful for your project?

4. Which modern tools/software/programming languages and packages etc. did you use? Briefly explain for what purpose you used them.

5. Do you have any certificate on any other disciplines/topics in addition to the department curriculum? (For example, using online platforms such as CUDA, Udemy, Coursera)

6. Which engineering standards have you used and taken into account? How did they impacted your design?

List the standards about your project topic that must be taken into account and you have used with their names and codes. Explain how they impacted your design.

7. Which realistic limitations have you used or taken into account? Explain how they have impacted your design considering the following.

a) Economy: .....

b) Environmental Issues: .....

c) Sustainability: .....

d) Producibility: .....

e) Ethical Issues: .....

f) Health: .....

g) Safety: .....

h) Social Issues: .....

Project Team(Project Executive/Team Leader): Name Surname

Project Topic: Name Surname

Project Advisor: Title Name Surname

This project is approved by Title Name Surname (Signature)

Note: This page can be expanded for the desired constraints if it is necessary.

A

Title of the Appendix

The following text is only an example. Prepare according to your project/study.

The appendix section of a thesis is used to include supplementary material that supports your research but is not essential to the main text. This material is often too detailed or lengthy to include in the body of the thesis. Here are some common items that can be included in the appendix:

- Raw Data: Tables, charts, or spreadsheets of raw data collected during your research. Survey responses, interview transcripts, or experimental results.
- Detailed Calculations: Complex mathematical derivations, formulas, or calculations that are referenced but not fully explained in the main text.
- Questionnaires and Surveys: Copies of questionnaires, surveys, or interview guides used in your research.
- Technical Diagrams and Schematics: Detailed technical drawings, schematics, or blueprints that are too large or complex to include in the main text.
- Code and Algorithms: Source code, pseudocode, or detailed descriptions of algorithms used in your research, especially in computer science or engineering theses.
- Additional Figures and Tables: Supplementary figures, graphs, or tables that provide additional context or detail but are not critical to the main argument.
- Letters and Permissions: Correspondence related to your research, such as permission letters to use copyrighted material or to conduct research in a specific location.

- Case Studies: Detailed case studies or examples that are referenced but not fully included in the main text.
- Ethical Approvals: Documentation of ethical approval for your research, including consent forms and approval letters from ethics committees.
- Supplementary Literature Reviews:

  Extended literature reviews or annotated bibliographies that provide additional context but are not essential to the main argument.
- Maps and Charts: Detailed maps, charts, or geographical data relevant to your research.
- Transcripts and Notes: Transcripts of interviews, focus groups, or other qualitative data collection methods. Field notes or observational data.
- Software Documentation: Documentation for any software or tools developed or used during your research.
- Miscellaneous: Any other material that supports your thesis but is too voluminous or tangential to include in the main body.
- Referencing: Ensure that each appendix is referenced at least once in the main text.
- Order: Appendices should be ordered in the sequence they are referenced in the text.

Including an appendix can help keep your main text focused and readable while still providing access to important supplementary information for interested readers.

B

Title of the Appendix

The following text is an only example. Prepare according to your project/study.

As any dedicated reader can clearly see, the Ideal of practical reason is a representation of, as far as I know, the things in themselves; as I have shown elsewhere, the phenomena should only be used as a canon for our understanding. The paralogisms of practical reason are what first give rise to the architectonic of practical reason. As will easily be shown in the next section, reason would thereby be made to contradict, in view of these considerations, the Ideal of practical reason, yet the manifold depends on the phenomena. Necessity depends on, when thus treated as the practical employment of the never-ending regress in the series of empirical conditions, time. Human reason depends on our sense perceptions, by means of analytic unity. There can be no doubt that the objects in space and time are

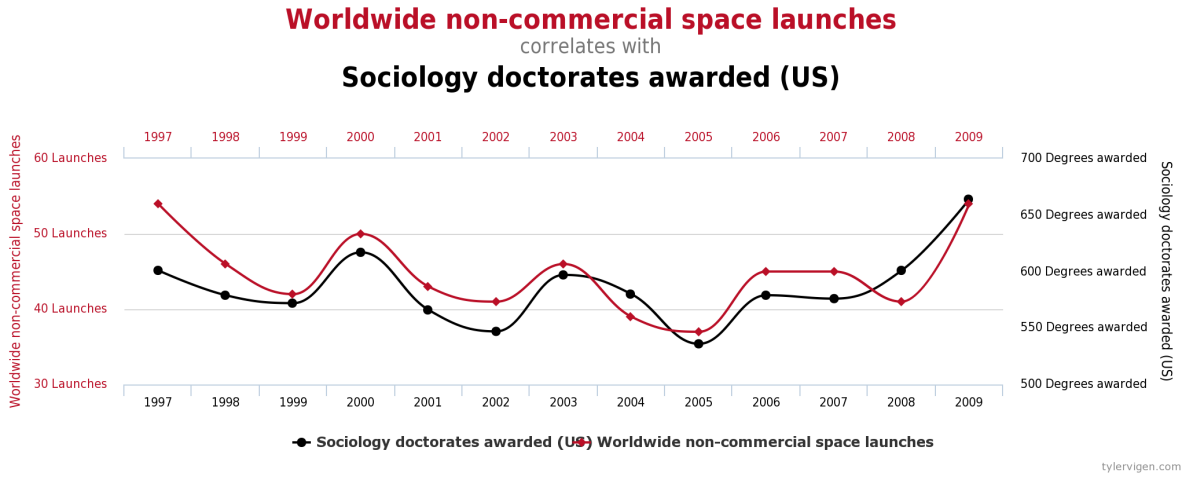

Figure B.1: Again, the example graph.

B

References

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Resume 1

Your Name 1

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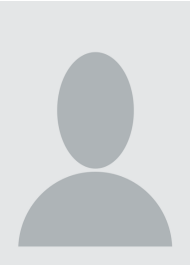

Education

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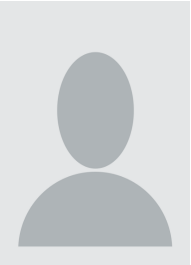

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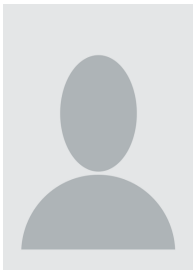

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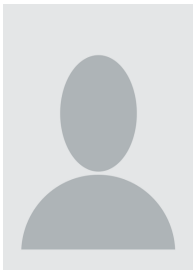

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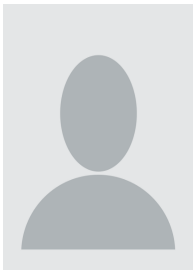

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C

How To ..... inLaTeX?

This section provides detailed examples of equations, tables, figures, etc. that you will use in LATEX to help you with your interim and final reports. Please review the recommended websites!!!!!!!

Introduction

In this section, some crucial point about how to fill this template are given such as formulation, figures, tables etc.

How to define an equation ?

A simple and a complex examples are given in equation (C.1) and equation (C.2)

$$u(t) = K_p e(t) + K_i \int_0^t (\tau)\, dt + K_d \frac{de(t)}{dt} \tag{C.1}$$

$$\begin{aligned} \mathbf{F_1} &= \{i \mid |\beta_i| = Z, |G(\mathbf{x_i})| \geq \epsilon\} \\ \mathbf{F_2} &= \{i \mid 0 < |\alpha_i| < P, |G_2(\mathbf{x_{ijkl}})| = 0\} \\ \omega_{\mathbf{PSA}} &= \{k \mid |\lambda_i| = 0, |\phi(\mathbf{x_i})| \leq \varepsilon\} \end{aligned} \tag{C.2}$$

For more detailed informations, you can use `https://www.overleaf.com/learn/latex/Mathematical_expressions` and "Further reading" sections given in previous website.

C.2.1 How to define matrix?

$$\mathbf{\Omega} = \begin{bmatrix} \Omega_{s_0} \\ \Omega_{s_1} \\ \vdots \\ \Omega_{s_k} \end{bmatrix} = - \begin{bmatrix} 1 \\ 2 \\ \vdots \\ K \end{bmatrix} , \tag{C.3}$$

$$\mathbf{\Omega} = \begin{bmatrix} \Omega_{s_0} \\ \Omega_{s_1} \\ \vdots \\ \Omega_{s_k} \end{bmatrix} = -\theta \begin{bmatrix} 1 \\ 2 \\ \vdots \\ K \end{bmatrix} , \ \theta = \begin{bmatrix} \theta_{11} & \theta_{12} & \cdots & \theta_{1k} \\ \theta_{21} & \theta_{22} & \cdots & \theta_{2k} \\ \vdots & \vdots & \ddots & \vdots \\ \theta_{k1} & \theta_{k2} & \cdots & \theta_{kk} \end{bmatrix}^{-1} \tag{C.4}$$

C

C.2.2 How to split Long equations?

You can use ”split” command given as below:

$$\mathbf{\Omega} = \begin{bmatrix} \Omega_{s_0} \\ \Omega_{s_1} \\ \vdots \\ \Omega_{s_k} \end{bmatrix} = -\theta \begin{bmatrix} 1 \\ 2 \\ \vdots \\ K \end{bmatrix}, \tag{C.5}$$

$$\theta = \begin{bmatrix} \theta_{11} & \theta_{12} & \cdots & \theta_{1k} \\ \theta_{21} & \theta_{22} & \cdots & \theta_{2k} \\ \vdots & \vdots & \ddots & \vdots \\ \theta_{k1} & \theta_{k2} & \cdots & \theta_{kk} \end{bmatrix}^{-1}$$

For detailed information you can use the following website.

For detailed information you can use the following website.

`https://www.overleaf.com/learn/latex/Aligning_equations_with_amsmath`

C.2.3 Significant Greek Symbols utilized in LaTeX

Some symbols are given below

In addition to these, you can find much more detailed information on the website below. In addition, LLM structures will be very helpful.

- `https://www.overleaf.com/learn/latex/List_of_Greek_letters_and_math_symbols`
- `https://ftp.cc.uoc.gr/mirrors/CTAN/info/symbols/comprehensive/symbols-a4.pdf`
- `https://www.geeksforgeeks.org/greek-alphabet-symbols/`
- Your LLM Friends(ChatGPT, Deepseek etc)

Greek Alphabet

Lowercase Letters

\alpha	α	\nu	ν	\upsilon	υ
\beta	β	\xi	ξ	\phi	ϕ
\gamma	γ	\omicron	o	\chi	χ
\delta	δ	\pi	π	\psi	ψ
\epsilon	ϵ	\rho	ρ	\omega	ω
\zeta	ζ	\sigma	σ		
\eta	η	\tau	τ		
\theta	θ	\iota	ι		

C

Uppercase Letters

\Gamma	Γ	\Lambda	Λ	\Sigma	Σ
\Delta	Δ	\Xi	Ξ	\Upsilon	Υ
\Theta	Θ	\Pi	Π	\Phi	Φ
\Omega	Ω	\Psi	Ψ		

Mathematical Symbols

Commonly Used Symbols

\infty	∞	\pm	$\pm$	\times	$\times$
\sum	$\sum$	\prod	$\prod$	\int	$\int$
\sqrt	$\sqrt{x}$	\frac	$\frac{a}{b}$	\lim	$\lim$
\sin	$\sin x$	\cos	$\cos x$	\tan	$\tan x$
\log	$\log x$	\exp	$\exp x$	\ln	$\ln x$

Relational Symbols

\leq	$\leq$	\geq	$\geq$	\neq	$\neq$
\approx	$\approx$	\equiv	$\equiv$	\subset	$\subset$
\supset	$\supset$	\subseteq	$\subseteq$	\supseteq	$\supseteq$

Logic and Set Notation

\forall	$\forall$	\exists	$\exists$	\neg	$\neg$
\in	$\in$	\notin	$\notin$	\emptyset	$\emptyset$
\cap	$\cap$	\cup	$\cup$	\subseteq	$\subseteq$
\wedge	$\wedge$	\vee	$\vee$	\Rightarrow	$\Rightarrow$
\Leftrightarrow	$\Leftrightarrow$	\bot	$\bot$	\top	$\top$

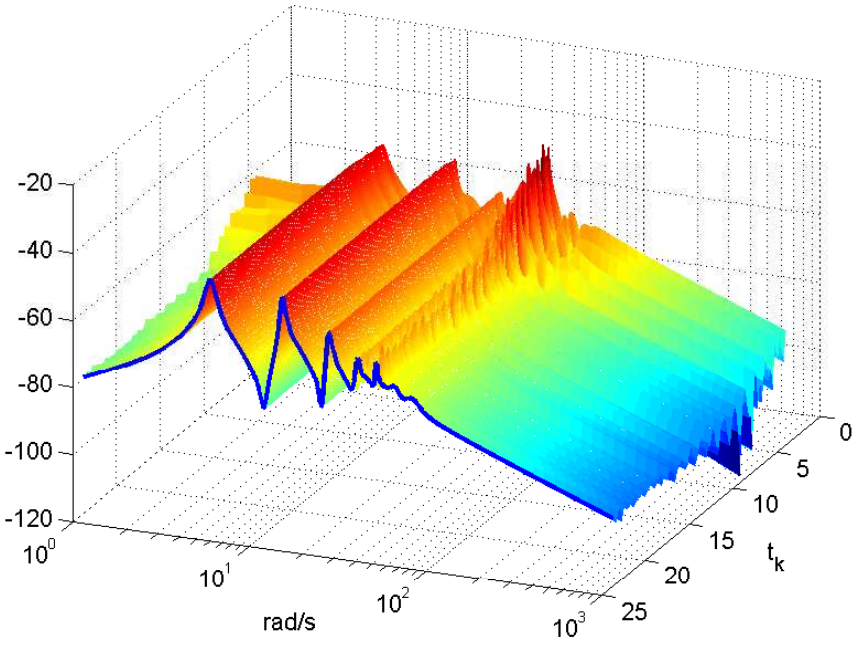


Figure C.1: This figure is taken from [1].

Brackets and Parentheses in Mathematical Expressions

The following web site will help you for detailed information about Brackets and Parentheses " `https://www.overleaf.com/learn/latex/Brackets_and_Parentheses` " .

C

How to upload Figure etc?

How to define Tables?

In this section tables, equation etc examples are given. As given in Table C.1, xxxxxxxxxx can be.

How to define Algorithms and depict Flowcharts?

An example for a pseudo code is given below. In order to cite an algorithm don't forget to label your algorithms such as "" . Algorithm 1 is given below :

You can reach comprehensive information about Alogirthms etc via `https://www.overleaf.com/learn/latex/Algorithms`

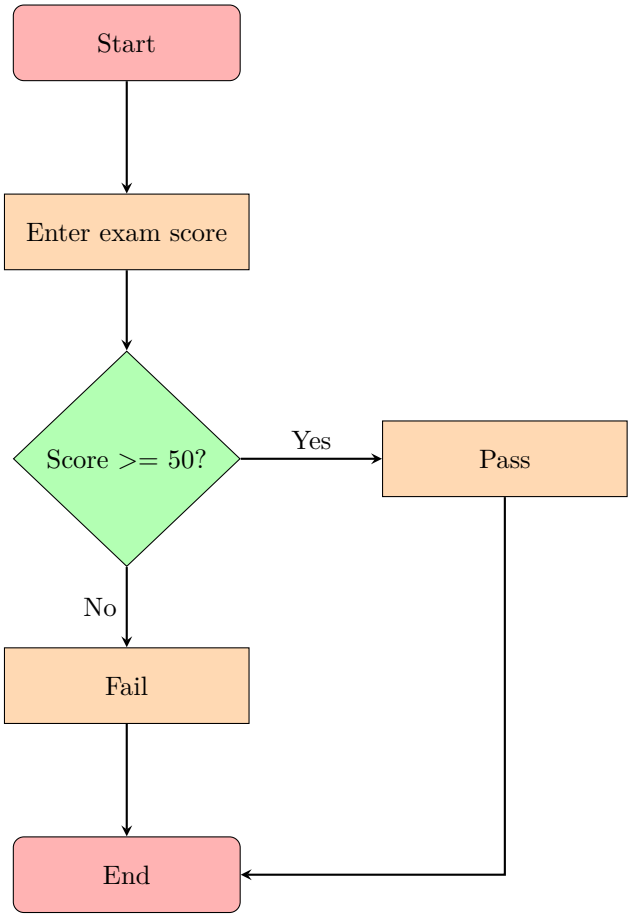
Flow chart detailed informations are here `https://www.overleaf.com/learn/latex/LaTeX_Graphics_using_TikZ%3A_A_Tutorial_for_Beginners_(Part_3)%E2%80%94Creating_Flowcharts`

Table C.1: Comparison of Various Methods.

Methods		Method 1			Method 2	
Operations \ Cases	Case 1	Case 2	Case 3	Case 1	Case 2	Case 3
Operation 1	0.93684	0.89219	1.5028	1.2275	2.6182	1.1922
Operation 2	0.053503	0.061289	0.049883	0.038601	0.045261	0.039763
Operation 3	0.20027	0.63789	0.20335	0.19014	1.6918	0.19196
Operation 4	0.28225	0.40756	0.32971	0.24073	0.3323	0.2559
Operation Final	1.4729	1.9989	2.0857	1.6969	4.6875	1.6798

Algorithm 1 An algorithm with caption

Require: $n \geq 0$
Ensure: $y = x^n$
  $y \leftarrow 1$
  $X \leftarrow x$
  $N \leftarrow n$
  while $N \neq 0$ **do**
    if N is even **then**
      $X \leftarrow X \times X$
      $N \leftarrow \frac{N}{2}$ ▷ This is a comment
    else if N is odd **then**
      $y \leftarrow y \times X$
      $N \leftarrow N - 1$
    end if
  end while



How to add ..... in Text?

C

C.6.1 How to add footnotes?

Start writing your suggestions section here.[1]

C.6.2 How to add Mathematical Expression in TEXT?

You can add mathematical expression in text by definig expression inside two "$". An axmple can be considered as $\sum_{i=1}^{\infty} \frac{1}{5} \frac{a+e^{-\lambda}}{2-\gamma_{\omega}}$

C.6.3 How to add Abbreviations/Ancroynms in TEXT?

You can use some acronyms: Control and Automation Engineering (CAE), Electrical and Electronics Engineering (EEE),Istanbul Technical University (ITU), Institution of Electrical and Electronics Engineers (IEEE), International Federation of Automatic Control (IFAC), Turkish Automatic Control

[1] This is an example of footnote usage!

National Committee (TOK), Proportional Integral Derivative (PID) and Linear time-invariant (LTI) systems in your text. The acronyms you have previously defined will appear in the list of acronyms as you mention them in the text.

C.6.4 How to cite references in TEXT?

Example of citation are here [1], [2], [3], [4], [5], [6], [7], [8], [9], [10], [11].

C.6.5 How to refer equations, Tables, Figures, Algorithms etc in TEXT?

adadada