Tartu University

Faculty of Science and Technology

Institute of Technology

Given_name Surname

My Thesis title

Master's thesis (30 EAP)
Robotics and Computer Engineering

Supervisor:

title Given_name Surname

Tartu 2019

Resümee/Abstract

Minu lõputöö pealkiri

Resümee ehk abstrakt on “kokkuvõtlik, oluliste seisukohtade ja väidete ülevaatlik esitus[..].

Eesmärk on võimalikult täpselt ja lühidalt edasi anda teksti sisu ja selles esitatud peamised väited. Oluline on faktiline korrektsus (ei lisata midagi, mida tekst ei toeta) ja kõige olulisemate seisukohtade esiletoomine.” [1].

Käesoleval juhul peaks abstrakt andma kondenseeritud ülevaate kogu tekstist, sealhulgas ka olulisematest tulemustest, sest see tekst kantakse üle Tartu Ülikooli raamatukogu elektrooniliste materjalide hoidlasse DSpace’i.

CERCS: T120 Süsteemitehnoloogia, arvutitehnoloogia; T125 Automatiseerimine, robootika, control engineering; (näidis: muuda, täienda vastaval oma töö sisule [2])

Märksõnad: arvutid, kontroll, robootika (näidis: muuda, täienda vastaval oma töö sisule)

My thesis title

Abstract is “a concise overview of important postitions and statements[..].

The aim is to convey the content of the thesis and the main statements contained therein as precisely and briefly as possible. Important is factual correctness (not adding something that is not supported by the text) and highlighting all important views.” [1].

CERCS: T120 Systems engineering, computer technology; T125 Automation, robotics, control engineering (an example: modifiy, complement according to the content of you thesis [2])

Keywords: computers, control, robotics (an example: modifiy, complement according to the content of you thesis)

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Lühendid, konstandid, mõisted

ROS - Robot Operating System

c - electromagnetic wave propagation speed in vacuum

1 Introduction

The introduction is a place where you put your problem into the so-called world context, the question is asked why is it necessary to investigate this problem. [3–5].

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1.1 Problem Statement

Give the overview and the essence of the problem [1, 5].

Sed commodo posuere pede. Mauris ut est. Ut quis purus. Sed ac odio. Sed vehicula hendrerit sem. Duis non odio. Morbi ut dui. Sed accumsan risus eget odio. In hac habitasse platea dictumst. Pellentesque non elit. Fusce sed justo eu urna porta tincidunt. Mauris felis odio, sollicitudin sed, volutpat a, ornare ac, erat. Morbi quis dolor. Donec pellentesque, erat ac sagittis semper, nunc dui lobortis purus, quis congue purus metus ultricies tellus. Proin et quam. Class aptent taciti sociosqu ad litora torquent per conubia nostra, per inceptos hymenaeos. Praesent sapien turpis, fermentum vel, eleifend faucibus, vehicula eu, lacus.

1.2 Objectives and Roadmap

Define the objectives of the thesis. Also describe the roadmap to achive the goals.

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sed mauris vitae elit sollicitudin malesuada. Maecenas ultricies eros sit amet ante. Ut venenatis velit. Maecenas sed mi eget dui varius euismod. Phasellus aliquet volutpat odio. Vestibulum ante ipsum primis in faucibus orci luctus et ultrices posuere cubilia Curae; Pellentesque sit amet pede ac sem eleifend consectetuer. Nullam elementum, urna vel imperdiet sodales, elit ipsum pharetra ligula, ac pretium ante justo a nulla. Curabitur tristique arcu eu metus. Vestibulum lectus. Proin mauris. Proin eu nunc eu urna hendrerit faucibus. Aliquam auctor, pede consequat laoreet varius, eros tellus scelerisque quam, pellentesque hendrerit ipsum dolor sed augue. Nulla nec lacus.

2 State of the Art

In this chapter you describe the most recent and relevant achievements in the field and in the thesis context based on the publications. Also, this overview should lead to the understanding of the stimuli of the thesis and make clear why the previous studies motivated the current research.

2.1 Experimental

The overview can include experimental results.

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2.2 Theoretical solutions. Simulations

The overview can include therotical solutions, simulation results etc.

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3 Methodology

In this chapter you describe the object you study, the reserach method(s) you use for the research and analysis, also research tools, materials etc.

3.1 Research Methods

Physical laws are usually described by the formulas:

$$\begin{cases} e_a \frac{\partial^2 u}{\partial t^2} + d_a \frac{\partial u}{\partial t} + \nabla \cdot (-c\nabla u - \alpha u + \gamma) + \beta \cdot \nabla u + au = f & piirkonnas \quad \Omega \\ \mathbf{n} \cdot (c\nabla u + \alpha u - \gamma) + qu = -g - h^T \mu & rajal \quad \partial\Omega \\ hu = r & rajal \quad \partial\Omega \end{cases} \tag{3.1}$$

This formula **3.1** is a partial differential equation with boundary conditons.

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3.2 Research Tools

Aliquam lectus. Vivamus leo. Quisque ornare tellus ullamcorper nulla. Mauris porttitor pharetra tortor. Sed fringilla justo sed mauris. Mauris tellus. Sed non leo. Nullam elementum, magna in cursus sodales, augue est scelerisque sapien, venenatis congue nulla arcu et pede. Ut suscipit enim vel sapien. Donec congue. Maecenas urna mi, suscipit in, placerat ut, vestibulum ut, massa. Fusce ultrices nulla et nisl.

3.3 Research Object

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3.4 Research Materials

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4 The Results

In this chapter you describe how did you reach the results and present the results.

4.1 Results in the First Method

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4.2 Results in the Second Method

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4.3 Results in the Third Method

These result are shown in Fig. **??**.

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5 Analysis and Discussion

In this chapter you analyse and discuss the result obtained in different methods, do the comparison and draw the conclusions.

5.1 Analysis of the Method One

The result can be presented as a table **5.1**.

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5.2 Analysis of the Method Two

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5.3 Discussion of the results

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Table 5.1: Simulated Models

Type	Simulation box /ÅxÅxÅ	EO	Salt	Li:EO	Particle diameter /Å	Temp. /K
A01	26x21x22	200	–	–	–	360
A02	26x21x22	200	LiCl	1:10	–	360
A03	26x21x22	200	LiBr	1:10	–	360
A04	26x21x22	200	LiI	1:10	–	360
A05	31x31x31	455	–	–	14	360
A06	31x31x31	455	–	–	14	360
A07	31x31x31	455	–	–	14	360
A08	31x31x31	455	LiCl	1:10	14	360
A09	31x31x31	455	LiBr	1:10	14	360
A10	31x31x31	455	LiI	1:10	14	360
A11	37x37x37	787	–	–	18	360
A12	37x37x37	787	–	–	18	360
A13	37x37x37	787	–	–	18	360
A14	37x37x37	787	LiCl	1:10	18	360
A15	37x37x37	787	LiBr	1:10	18	360
A16	37x37x37	787	LiI	1:10	18	360
B01	24x24x24	200	$LiBF_4$	1:20	–	293
B02	31x31x31	455	$LiBF_4$	1:20	14	293
B03	14x14x200	294	$LiBF_4$	1:20	slab	293
C01	28x22x24	200	LiCl	1:20	–	290, 330
C02	28x22x24	200	LiCl	1:35	–	290, 330
C03	28x22x24	200	LiCl	1:50	–	290, 330
C04	33x33x33	455	LiCl	1:20	14	290, 330
C05	33x33x33	455	LiCl	1:35	14	290, 330
C06	33x33x33	455	LiCl	1:50	14	290, 330

6 Conclusion

The conlusion in the part, where you conclude if you did reach to objectives set up in the beginning of the thesis, if the results did confirm the hypothesis or if the device you designed was built and functioned as expected. You bring out and formulate all the major results and the relations betweem them. No new data is presented.

Also, you can present the ideas, how to continue the results, is it's possible at all or essential. Nulla ac nisl. Nullam urna nulla, ullamcorper in, interdum sit amet, gravida ut, risus. Aenean ac enim. In luctus. Phasellus eu quam vitae turpis viverra pellentesque. Duis feugiat felis ut enim. Phasellus pharetra, sem id porttitor sodales, magna nunc aliquet nibh, nec blandit nisl mauris at pede. Suspendisse risus risus, lobortis eget, semper at, imperdiet sit amet, quam. Quisque scelerisque dapibus nibh. Nam enim. Lorem ipsum dolor sit amet, consectetuer adipiscing elit. Nunc ut metus. Ut metus justo, auctor at, ultrices eu, sagittis ut, purus. Aliquam aliquam.

Acknowledgements

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It would be nice to add a scanned image of you handwritten signature after the acknowledgements.

Bibliography

[1] Vikipeedia, vaba entsüklopeedia 2015. - Resümee. http://et.wikipedia.org/w/index.php?title=Res%C3%BCmee&oldid=4093046 7.04.2015, 07:14 (UTC).

[2] Common European Research Classification Scheme (CERCS) Teadusvaldkondade ja -erialade klassifikaator https://www.etis.ee/Portal/Classifiers/Details/d3717f7b-bec8-4cd9-8ea4-c89cd56ca46e (ETIS); PDF: https://wiki.ut.ee/download/attachments/16581162/Common%20European%20Research%20Classification%20Scheme.pdf

[3] Gname1. Surname1, Gname2. Surname2 ja Gname3. Surname3, "Papaer Title", *Journal Title*, **volume**, year, first_page-last_page, DOI:number.

[4] M. Winter, J. O. Besenhard, M. E. Spahr, and P. Novák, "Insertion electrode materials for rechargeable lithium batteries", *Advanced Materials*, 1998, **10**, 725–763, DOI:10.1002/(SICI)1521-4095(199807)10:10¡725::AID-ADMA725¿3.0.CO;2-Z.

[5] R. M. Dell and D. A. J. Rand, "Energy storage — a key technology for global energy sustainability", *J. Power Sources*, 2001, **100**, 2–17, DOI:10.1016/S0378-7753(01)00894-1.

[6] I. T. Masters, *Practical Neural Network Recipes in C++*, Academic, New York, 1993.

[7] I. B. L. Shoop, A. H. Sayles, and D. M. Litynski, "New devices for optoelectronics: smart pixels," in *Handbook of Fiber Optic Data Communications*, C. DeCusatis, D. Clement, E. Maass, and R. Lasky, eds., Academic, San Diego, Calif., 1997, pp. 705-758.

[8] I. R. E. Kalman, "Algebraic aspects of the generalized inverse of a rectangular matrix," in *Proceedings of Advanced Seminar on Genralized Inverse and Applications*, M. Z. Nashed, ed., Academic, San Diego, Calif., 1976, pp. 111-124.

[9] D. Steup and J. Weinzierl, "Resonant THz-meshes," presented at the Fourth International Workshop on THz Electronics, Erlangen-Tennenlohe, Germany, 5-6 Sept. 1996.

[10] D. Steup and J. Weinzierl, "Resonant THz-meshes," Abstracts of the Fourth International Workshop on THz Electronics, Erlangen-Tennenlohe, Germany, 5-6 Sept. 2004, Academic, San Diego, 2005, p. 111-112.

[11] I. D. Piao, Q. Zhu, N. K. Dutta, S. Yan, and L. L. Otis, "Cancelation of coherent artifacts in optical coherence tomography imaging," *Appl. Opt.*, accepted for publication.

Appendices

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