Reinforcement learning based control of an underactuated double pendulum system

Master's Thesis Nr.   xxx

Scientific Thesis for Acquiring the Master of Science Degree
at the School of Engineering and Design
of the Technical University of Munich.

Thesis Advisor   Laboratory for Product Development and Lightweight Design
                                Prof. Dr. Markus Zimmermann

Supervisor   Laboratory for Product Development and Lightweight Design
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Submitted on   Garching, 15.11.2023

Declaration

I assure that I have written this work autonomously and with the aid of no other than the sources and additives indicated.

Garching, 15.11.2023

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Chi Zhang

Project Definition (1/2)

Initial Situation

Add your Project Brief here. If you don't need it, comment out the creation of this Project Brief in the main document `Thesis.tex`.

Goals

Hello, here is some text without a meaning. This text should show what a printed text will look like at this place. If you read this text, you will get no information. Really? Is there no information? Is there a difference between this text and some nonsense like "Huardest gefburn"? Kjift – not at all! A blind text like this gives you information about the selected font, how the letters are written and an impression of the look. This text should contain all letters of the alphabet and it should be written in of the original language. There is no need for special content, but the length of words should match the language.

Contents of this Thesis

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  - Lorem ipsum dolor sit amet
  - Lorem ipsum dolor sit amet
  - Lorem ipsum dolor sit amet
- Lorem ipsum dolor sit amet
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Project Note

Master's Thesis	Nr. xxx
Supervisor	Akhil Sathuluri
Partners in industry/research	DFKI GmbH, Robotics Innovation Center
Time period	15.05.2023 - 15.11.2023

The dissertation project of Akhil Sathuluri set the context for the work presented. My supersivor Akhil Sathuluri mentored me during the compilation of the work and gave continuous input. We exchanged and coordinated approaches and results monthly.

An accurate elaboration, a comprehensible and complete documentation of all steps and applied methods, and a good collaboration with industrial partners are of particular importance.

Publication

I consent to the laboratory and its staff members using content from my thesis for publications, project reports, lectures, seminars, dissertations and postdoctoral lecture qualifications.

The work remains a property of the Laboratory for Product Development and Lightweight Design.

Garching, 15.11.2023

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Chi Zhang

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Akhil Sathuluri

Contents

1 Introduction

This chapter is an introduction part of the whole thesis,

blablablakdsjfa;lkdsjfmxnvz.,mnvc.z,mvchl;kasjd;lkfjbx;ck,bvxcbn.jhdglkjbnsgflkajherwtlkjbndm,bv,mc

1.1 Motivation

This section is about the motivation of the whole thesis

1.2 Contribution

This section is about the contribution of the whole thesis

1.3 Content

This section is a conclusion of all the content of the thesis

2 State of the art

This chapter is about the state of the art.

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2.1 Theory

This section is about the theory, for example dynamics and underactuated control.

2.2 Related work

This section is about the related work about this project.

3 Methodology

This chapter is about the Methodology.

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3.1 Soft actor critic

This section is about SAC.

3.2 Linear quadratic regulator

This section is about LQR

3.3 Combining SAC and LQR with region of attraction

This section is about how to use ROA to combine SAC and LQR

3.4 Reward shaping

This section is about the reward shaping problem of reinforcement learning training.

4 Experiment: hardware system

This chapter is about the hardware experiment.

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4.1 Hardware setup

This section is about hardware setup and its features.

4.2 system identification

This section is about the system identification problem when using hardware system.

4.3 sim2real problem

This section is about sim2real problem.

4.4 real hardware results

This section is about simulation results in pendubot and acrobot.

pendubot:

acrobot:

5 Discussion

This chapter is about the discussion of results.

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5.1 introduction to leaderboard results

This section is about hardware setup and its features.

5.2 interpretation of simulation results

This section is about explaining the simulation results.

5.3 interpretation of hardware results

This section is about explaining the hardware results.

5.4 future work

This section is to talk about things to be done.

Appendix

A An appendix

You can structure appendices, just like your thesis, with the `\chapter`, `\section`, and `\subsection` commands. Referencing also works as usual.

If your thesis does not contain an appendix, comment out the creation of the appendix at the appropriate place in the `Thesis.tex` file.