



TECHNISCHE UNIVERSITÄT
CHEMNITZ

Humanoid robot learns walking by human demonstration

Master Thesis

Submitted in Fulfilment of the
Requirements for the Academic Degree
M.Sc.

Dept. of Computer Science
Chair of Computer Engineering

Submitted by: Juncheng Hu
Student ID: 427791
Date: 16.01.2018

Supervising tutor: Dr. John Nassour

Abstract

In this paper, a method designed for making the humanoid robot walking is developed by using the DQN in reinforcement learning. Machine learning has demonstrated a promising feature in many fields including robotics. However the supervised learning algorithms are more often applied. But supervised learning like neural networks always need a huge amount of data to train, which is sometimes not permitted in real situation. Although not much data is required in reinforcement learning, it need many attempts in its environment thus concluding a strategy. For a humanoid robot, it is not allowed to have too much bad attempts because a fall down may lead to the injury of a joint. In this paper a method that the robot learns walking with the help of a human can avoid unnecessary falls is proposed.

Keywords: humanoid robot, reinforcement learning, robot walking

Contents

Contents	3
List of Figures	4
List of Tables	5
List of Abbreviations	6
1 Introduction	7
1.1 Robot	7
1.2 NAO	7
1.3 CPG	7
2 State of art	8
3 Implementation	9
3.1 Implementation Swing on Nao by Q-learning	9
4 Referencing	10
Bibliography	12

List of Figures

List of Tables

List of Abbreviations

KDE K Desktop Environment

SQL Structured Query Language

Bash Bourne-again shell

JDK Java Development Kit

VM Virtuelle Maschine

IC Inter-Integrated Circuit

KDE K Desktop Environment

SQL Structured Query Language

Bash Bourne-again shell

JDK Java Development Kit

VM Virtuelle Maschine

IC Inter-Integrated Circuit

KDE K Desktop Environment

SQL Structured Query Language

Bash Bourne-again shell

JDK Java Development Kit

VM Virtuelle Maschine

IC Inter-Integrated Circuit

KDE K Desktop Environment

SQL Structured Query Language

Bash Bourne-again shell

JDK Java Development Kit

VM Virtuelle Maschine

IC Inter-Integrated Circuit

KDE K Desktop Environment

SQL Structured Query Language

Bash Bourne-again shell

JDK Java Development Kit

VM Virtuelle Maschine

IC Inter-Integrated Circuit

KDE K Desktop Environment

SQL Structured Query Language

Bash Bourne-again shell

JDK Java Development Kit

VM Virtuelle Maschine

IC Inter-Integrated Circuit

1 Introduction

1.1 Robot

1.2 NAO

1.3 CPG

2 State of art

2.1

3 Implementation

3.1 Implementation Swing on Nao by Q-learning

As it is mentioned in previous chapter, the Q-learning method could be used to realize many control problems. In this section, the Q-learning algorithm is used to control the 2 alpha values based on CPG algorithm

4 Referencing

Lorem ipsum dolor sit amet, consectetur adipiscing elit. Etiam lobortis facilisis sem. Nullam nec mi et neque pharetra sollicitudin. Praesent imperdiet mi nec ante. Donec ullamcorper, felis non sodales commodo, lectus velit ultrices augue, a dignissim nibh lectus placerat pede. Vivamus nunc nunc, molestie ut, ultricies vel, semper in, velit. Ut porttitor. Praesent in sapien. Lorem ipsum dolor sit amet, consectetur adipiscing elit. Duis fringilla tristique neque. Sed interdum libero ut metus. Pellentesque placerat. Nam rutrum augue a leo. Morbi sed elit sit amet ante lobortis sollicitudin. Praesent blandit blandit mauris. Praesent lectus tellus, aliquet aliquam, luctus a, egestas a, turpis. Mauris lacinia lorem sit amet ipsum. Nunc quis urna dictum turpis accumsan semper. [2]

Lorem ipsum dolor sit amet, consectetur adipiscing elit. Etiam lobortis facilisis sem. Nullam nec mi et neque pharetra sollicitudin. Praesent imperdiet mi nec ante. Donec ullamcorper, felis non sodales commodo, lectus velit ultrices augue, a dignissim nibh lectus placerat pede. Vivamus nunc nunc, molestie ut, ultricies vel, semper in, velit. Ut porttitor. Praesent in sapien. Lorem ipsum dolor sit amet, consectetur adipiscing elit. Duis fringilla tristique neque. Sed interdum libero ut metus. Pellentesque placerat. Nam rutrum augue a leo. Morbi sed elit sit amet ante lobortis sollicitudin. Praesent blandit blandit mauris. Praesent lectus tellus, aliquet aliquam, luctus a, egestas a, turpis. Mauris lacinia lorem sit amet ipsum. Nunc quis urna dictum turpis accumsan semper. ¹

Lorem ipsum dolor sit amet, consectetur adipiscing elit. Etiam lobortis facilisis sem. Nullam nec mi et neque pharetra sollicitudin. Praesent imperdiet mi nec ante. Donec ullamcorper, felis non sodales commodo, lectus velit ultrices augue, a dignissim nibh lectus placerat pede. Vivamus nunc nunc, molestie ut, ultricies vel, semper in, velit. Ut porttitor. Praesent in sapien. Lorem ipsum dolor sit amet, consectetur adipiscing elit. Duis fringilla tristique neque. Sed interdum libero ut metus. Pellentesque placerat. Nam rutrum augue a leo. Morbi sed elit sit amet ante lobortis sollicitudin. Praesent blandit blandit mauris. Praesent lectus tellus, aliquet aliquam, luctus a, egestas a, turpis. Mauris lacinia lorem sit amet ipsum. Nunc quis urna dictum turpis accumsan semper. ² Lorem ipsum dolor sit amet, consectetur adipiscing elit. Etiam lobortis facilisis sem. Nullam nec mi et neque pharetra sollicitudin. Praesent imperdiet mi nec ante. Donec ullamcorper, felis non sodales commodo, lectus velit ultrices augue, a dignissim nibh lectus placerat pede. Vivamus nunc nunc, molestie ut, ultricies vel, semper in, velit. Ut porttitor.

¹Here is an area for your Notes

²[4] Seite 11

Praesent in sapien. Lorem ipsum dolor sit amet, consectetur adipiscing elit. Duis fringilla tristique neque. Sed interdum libero ut metus. Pellentesque placerat. Nam rutrum augue a leo. Morbi sed elit sit amet ante lobortis sollicitudin. Praesent blandit blandit mauris. Praesent lectus tellus, aliquet aliquam, luctus a, egestas a, turpis. Mauris lacinia lorem sit amet ipsum. Nunc quis urna dictum turpis accumsan semper. [4] Lorem ipsum dolor sit amet, consectetur adipiscing elit. Etiam lobortis facilisis sem. Nullam nec mi et neque pharetra sollicitudin. Praesent imperdiet mi nec ante. Donec ullamcorper, felis non sodales commodo, lectus velit ultrices augue, a dignissim nibh lectus placerat pede. Vivamus nunc nunc, molestie ut, ultricies vel, semper in, velit. Ut porttitor. Praesent in sapien. Lorem ipsum dolor sit amet, consectetur adipiscing elit. Duis fringilla tristique neque. Sed interdum libero ut metus. Pellentesque placerat. Nam rutrum augue a leo. Morbi sed elit sit amet ante lobortis sollicitudin. Praesent blandit blandit mauris. Praesent lectus tellus, aliquet aliquam, luctus a, egestas a, turpis. Mauris lacinia lorem sit amet ipsum. Nunc quis urna dictum turpis accumsan semper. [2, 3, 1]

Bibliography

- [1] Chen, T.: Audiovisual speech processing. IEEE Signal Processing Magazine 18(1), 9–21 (2001)
- [2] Glueck, H.I.: Autorenrichtlinien zur gi-edition lecture notes in informatics (lni) (2005), http://www.gi-ev.de/fileadmin/redaktion/2005_LNI/LNI-Autorenrichtlinien.pdf
- [3] Pepper, P.: Grundlagen der Informatik. Oldenbourg (1992)
- [4] Tolksdorf, R.: Die lni dokumentenklasse fr latex (1212), <http://www.gi-ev.de/fileadmin/redaktion/Autorenrichtlinien/LNILaTeX-Vorlage.zip>