MODELING OF BIPEDAL ROBOT NEGOTIATING SLOPES

A dissertation submitted to the
Department of Electrical Engineering, University of Moratuwa
in partial fulfilment of the requirements for the
Degree of Master of Science

by
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2010

Abstract

This research shows how the robotics theories are applied to model the bipedal walking robot. Utilizing the direct kinematics and inverse kinematics, the kinematic model for the robot is developed. The derivation of joint angle equations for 6 links Robot, walking on a slopping surface, is a direct approach in this research. The development of hip trajectory is another important invention specific to this research.

The dynamic stability is analyzed by utilizing ZMP criteria. The calculation of ZMP for this model is very complex and based on mechanics theories. The selection of iteration method to calculate linear accelerations of each link (which are used to calculate ZMP) is guaranteed by simulation results.

The dynamic stability is analyzed for lower body using ZMP simulation results. For this case the "Dynamic" Balance Margin (DBM) is introduced and requirement for stability is also introduced.

The methods or precautions that can be used to improve ZMP are identified. The most effected method for improve the stability is selected as control of torso angle. Finally, the modified ZMP is re-derived with the term of torso angle and it is found that the ZMP can be moved to safe margin by controlling torso angle. The results show the effectiveness of the proposed methodology.

DECLARATION

The work submitted in this dissertation is the result of my own investigation, except where otherwise stated.

It has not already been accepted for any degree, and is also not being concurrently submitted for any other degree.

UOM Verified Signature

Name of Candidate - M.G.A.P. Abeyratne
Date – 8th February 2010

We/I endorse the declaration by the candidate.

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Acknowledgement

I express my gratitude to my supervisor, Professor Lanka Udawatta, for his great supervision, guidance and support provided to me to do this research. My sincere thanks go to the officers in Post Graduate Office, Faculty of Engineering, University of Moratuwa, Sri Lanka for helping me in various ways to clarify the things related to my academic works in time with excellent assistance. Sincere gratitude is also extended to the people who serve in the Department of Electrical Engineering office for their immense support provided to me.

I extend my sincere appreciation to Dr. Thrishantha Nanayakkara in Kingston College, London for his valuable support and for furnishing new information in the field of biped robot. Also, thanks are due to Mr. S.M. Welihinda, who helped me by simulating the derived model and showing the correctness of the derivations.

An especial thank is due to my spouse, Mrs. H.M.S.N. Kularatne, for providing utmost support in preparing this dissertation properly.

Sincere thanks are due to many individuals, friends and colleagues who helped me in various ways to complete this project. May be I would not be able to made it without the support of you all.

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