BEHA VIOURAL ANALYSIS OF BIPEDAL ROBOT

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Degree of Master of Science

by

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Abstract

In this thesis a 7 OoF bipedal robot has been simulated, and analyzed its behavior by varying torso angle to achieve dynamic stability while walking on sloping surfaces. The revolutionary dynamic stability criteria introduced by Prof. Miomir Vukobratovic in 1969 has been used throughout the thesis. The dynamically stable human walking on slopes are very complex and this thesis address this problem by starting from lower body and in the middle by adding a torso with the intention of gaining dynamic stability and finishes showing the effectiveness of the variation of torso angle.

The ZMP formula presented in the paper of Prof. Miomir Vukobratovic is involved with huge computations and due to that most of the researches in this field have chosen alternatives such as GA and NN to find the ZMP. Although it is convenient to use GA and NN to avoid mathematical calculation the accuracy of resultant ZMP is questionable. The original ZMP equation has been used extensively in all cases to calculate ZMP in this thesis and rather verifies the accuracy of this concept.

The simulations have been performed to verify the accuracy of the kinematics models that has been created before moving to the ZMP calculations. The effectiveness of the variation of torso angle on the dynamic stability of the bipedal robot has been analyzed by varying slope angle, step length and step time. It is indicated using real ZMP calculations the bipedal robot can maintain its dynamic stability while walking on slopes at any circumstances.

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

Saman Manjula Welihinda

Date -08-02-2010

I endorse the declaration by the candidate.

UOM Verified Signature

Prof. Lanka Udawatta

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List of Abbreviations

α	Slope Angle
DoF	Degrees of Freedom
g	Acceleration due to gravity
SL	Step length
T	Step Time
D-H	Denavit-Hartenberg notation
L_i	Length of link i
ZMP	Zero moment point
FRI	Foot rotation index
FZMP	Fictional zero moment point
L_T	Length of Torso
m_T	Mass of Torso
θ_T	Torso angle
GA	Genetic algorithm
NN	Neural network
COM	Centre Of Mass
NPCM	Normal Projection of the Centre of Mass
C_i	Cosine of joint angle i
S_i	Sine of joint angle i
$q_i(t)$	Joint angle at time t

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