

بسم الله الرحمن الرحيم





شبكة المعلومات الجامعية التوثيق الالكتروني والميكرو فيلم



جامعة عين شمس

التوثيق الإلكتروني والميكروفيلم

قسم

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Ain Shams University
Faculty of Engineering
Mechatronics Department

Dynamic walking control of humanoid lower limb

A Thesis submitted in partial fulfillment of the requirements of the degree
of Master of Science in Mechanical Engineering
(Mechatronics Engineering)

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Statement

This thesis is submitted as a partial fulfilment of Master of Science in Mechanical Engineering (Mechatronics Engineering), Faculty of Engineering, Ain Shams University.

The author carried out the work included in this thesis, and no part of it has been submitted for a degree or a qualification at any other scientific entity.

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List of Publications

- Mohamed, Samer A., Mohammed I. Awad, and Shady A. Maged.
"Online Gait Generation For NAO Humanoid Robot Using Model
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Abstract

Humanoid robots will have many applications in the industrial sector in near future. Based on this motivation, the thesis presents a complete study on humanoid robot kinematics and dynamics. The thesis also discusses some basic methods for walking pattern generation and elaborates on some modifications to enhance the basic walking pattern generation methods in terms of stability and power consumption optimization. The thesis then proceeds to introduce some stabilization techniques using ZMP feedback and upper body posture correction. The suggested algorithms were validated using MATLAB [104] simulations for NAO robot. The presented methods produced satisfactory results in terms of stability, as the RMSE for ZMP x-coordinates (x-axis being parallel to walking direction), ZMP y-coordinates, upper body roll angle deviation and upper body pitch angle deviation were found to be 0.0028 m, 0.0139 m, 0.0028 rad and 0.0014 rad respectively. Also, the presented work contributed significantly to humanoid walking power consumption optimization as the average locomotion cost of transport was reduced from 0.2367 to 0.11993.

Keywords: bipedal; model-predictive control; humanoid; cart-table model; cost of transport; linear inverted pendulum model; Zero moment point; bio-inspired robotics; trajectories; center of mass.

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