DEVELOPMENT OF PNEUMATIC ROBOT ARM CONTROLLER FOR INDUSTRIAL APPLICATION

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

by

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April 2008

DECLARATION

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

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

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Date: 07/04/2008

I endorse the declaration by the candidate.

UOM Verified Signature

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Abstract

This research study focuses on developing a pneumatic robot arm for industrial applications, where the discussion here is narrowed down to the application of Pneumatic Artificial Muscles (PAM) on bicep configuration. When compared with other robotic actuators Pneumatic muscles have several advantages such as lower power to weight ratios, high strength, lightweight and easiness of employment. Hence pneumatic artificial muscles have become more attractive actuators in industrial robotics applications. A pneumatic muscle analysis was carried out with the help of practical results which were obtained with a prototype experiment. It was realized that the muscle behaves in a non-linear manner which is the main disadvantage. The system equation is linearised in order to derive the state space model. With this the system would be linearised only within a small range of inputs, where it is impossible to use it as a general model with whole range of inputs.

A simulation study has been carried out for the system using Matlab/Simulink environment for various categories of inputs and it is experienced that the system responded to linear input signal, as per anticipated output of the theoretical analysis. Even though the above paradigm is discussed for single pneumatic sub-systems, it is emphasized, that the same approach can effectively be extended without any major conceptual breakthrough to any number of muscles. Depending on the application the pneumatic muscle may require different contraction profiles, where the controlling task of the muscle contraction would be vital.

To obtain the desired tracking of the actual performance, Inversion Based Control (IBC) concept has been employed. Simulated results showed the proposed methodology could be effectively applied. Further, investigations need to be carried out to model the complete system with other perturbations and apply the inversion based control concept for precise control of the tip of the arm.

Acknowledgement

I specially thank my supervisor, Dr. Lanka Udawatta for his unwavering guidance, support and advice for carrying out this research work successfully. I am also very appreciative for his extensive help in fulfillment of some publications related to this research work, in some prestigious international forums.

I am indebted to my parents for constant support and encouragement for successfully carrying out this work. My gratitude is also due to Prof. H.Y.R. Perera, Head/Electrical Engineering, for the support given with my studies. My sincere thanks to the chairman and the committee members of the SRC grant committee, University of Moratuwa, for the grant provided, which existed as an extensive support in my research studies. Dr. N Munasinghe and his staff, at the Engineering Post Graduate Unit, are also thanked for all assistance extended.

I would like to take this opportunity to extend my thanks to Dr. Thrishantha Nanayakkara, Dr. Palitha Dassanayaka and Dr. Sisil Kumarawadu for being the members of the review committee for my research. If not for their guidance and advice this work wouldn't have been a success at the end.

I have been assisted extensively by Mr. Pasidu Pallewella , Mr. Gamini Jayasinghe Mr. Geeth Jayendra, in developing the prototypes for the research work which I should greatly appreciate. I would also like to thank Mr. Buddhika Jayasekera, Mr. Dharshana Prasad, Ms. Imali Hettiarachchi and Mr. Chang Jong Baek, who have been my colleagues at the Departmental Research Lab, for helping me in various ways for successfully carrying out this work.

Finally, my thanks go to various other personnel without whose help this work wouldn't be a success. Understandably, their individual names cannot be mentioned here due to being large in number.

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