UNIVERSITI TEKNOLOGI MARA

DEVELOPMENT OF LEARNING ALGORITHM OF PASSIVE JOINT FOR 3R UNDER-ACTUATED ROBOT

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Thesis submitted in fulfillment
of the requirements for the degree of
Master of Science

Faculty of Mechanical Engineering

November 2015

AUTHOR'S DECLARATION

I declare that the work in this thesis was carried out in accordance with the regulations of Universiti Teknologi MARA. It is original and is the results of my own work, unless otherwise indicated or acknowledged as referenced work. This thesis has not been submitted to any other academic institution or non-academic institution for any degree or qualification.

I, hereby, acknowledge that I have been supplied with the Academic Rules and Regulations for Post Graduate, Universiti Teknologi MARA, regulating the conduct of my study and research.

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ABSTRACT

Position angle analysis by learning algorithm on robotics is extremely important and is widely used as a tool for predictive maintenance to detect faults and mechanical problems. However, in this project position angle analysis was limited to determine position angle for passive joint. Two different techniques were tested using three rotations (3R) under-actuated robot manipulator. The approach embedded Artificial Neural Network (ANN) algorithm and SIMULINK block diagram. Experiments were conducted to predict an algorithm on position angle measurement either SIMULINK block diagram or program code method applied to three joints; Active 1, Active 2 and Passive respectively. MATLAB software was utilized for data acquisition and analysis for the passive position of 3R under-actuated robot manipulator. The experiment test-rig used in this study was a platform with two (2) DC motor for active (Active 1 and Active 2) joints and rotary digital encoder for acquiring real time output of position angle. Joints of Active 1 and Active 2 were controlled by DC motor and the reference angles were between 0 degree to 45 degree with 5 degree intervals. Overall position angle for passive of both techniques were evaluated and compared. Based on those methods, observations of the correlation between INPUT-OUTPUT relationships have shown positive achievement for positioning of the passive joint of 3R under-actuated robot manipulator. As a conclusion, the results of the experiment on both of the methods have potentially shown relation to the prediction capacity of the algorithm for the 3R under-actuated robot. As a result, ANN of experiment was in acceptable in terms of positioning accuracy and prediction of passive joint.

ACKNOWLEDGEMENTS

All praise to Allah S.W.T., God the Almighty. Peace and blessings upon Prophet Muhammad S.A.W. Thanks to Allah S.W.T, for His blessings which allowed me to successfully finish this research, for the strength that He gave to me to withstand all obstacles, as well as for the patience that He granted me in order to carry out the experiments and fulfill the requirement of the research.

First and foremost, I would like to express my gratitude to my dedicated Supervisor, Dr. Sukarnur bin Che Abdullah who continuously mentored, guided and advised me throughout the progression of completing this research. Also, thank you very much to my Co-Supervisor, Mr. Mohd Hanif bin Mohd Ramli for his assistance and support.

I would like to convey my appreciation to Universiti Teknologi MARA (UiTM), Shah Alam that allowed and facilitated the experiment laboratory and apparatus. Special thanks to Mr. Mohamad Fauzi bin Md Said, the Laboratory Assistant who given many contributions towards achieving the findings of this research.

Next, I would like to express my innermost appreciation to my family, especially to my beloved parents, Haji Yaakob bin Haji Yusoff and Hajjah Siti Aishah binti Haji Ahmad and my beloved wife, Dr. Athirah binti Ab. Rahman for their endless understanding, moral support and encouragement towards me throughout the time.

Lastly, a special gratitude to my colleagues especially Doctoral (PhD) candidate, Mr. Mustafa J. Hayawi, my close friend, Mr. Muhammad Darawi bin Othman and all lecturers of Faculty of Mechanical Engineering, UiTM Shah Alam for their support during the completion of this research. Also, to all parties involved either directly or indirectly in order to ensure the success of this research.

Thank you, syukran jazilan.

CHAPTER ONE
INTRODUCTION

1.1 BACKGROUND OF RESEARCH

Usually, the word 'robot' is associated with moving machine. The development of robots has grown rapidly in the last three decades from involvement in science fiction fantasy to computer-controlled industrial robots. The industrial robot may be regarded as robotic manipulator or robotic arm (Robert, 2000). Its shape is commonly similar to human arm. It looks like a chain of rigid links interconnected by flexible joints. The links are similar to human anatomy such as chest, upper arm and forearm while the joints are similar to shoulder, elbow and wrist.

Nowadays, the robot industries tycoons are contented and pleased as there are increasing demands of robots in various fields. Various kind of robots have been designed for different purposes and most of the robot manipulators in operation are being used in automotive industry for instance for welding and painting purposes. In this regard, under-actuated robot could be a better choice for robot especially in space and it has led to many studies to predict its behavior (Yu, Shito, Inooka, 1998; Berkemeier, & Fearing, 1999; Spong, 1995; Ono, Yamamoto, & Imadu, 2001; Nakanishi, Fukuda, & Koditschek, 2000; Funda, Taylor, Eldridge, Gomory, & Gruben, 1996).

Vivek, Helge and Sunil (2008) in their finding discovered that the mathematical complexity and wide variety of applications have kept under-actuated systems as an area of active research. Many researchers use three links in their studies and most of them are focusing for controllability or vibration noise of the link. For example, Vivek, Helge and Sunil (2008) consider the first two joints as active and the last joint as passive with the use of a torque spring. While Francesco and Kevin (2001) look for vibration noise using the similar methodology but their configuration is passive for the first link and active for the other links.

This research is an attempt to characterize and assess three (3) degrees of freedom (DOF) robotic manipulator with two active links and a passive joint. It is very difficult to