UNIVERSITI TEKNOLOGI MARA

BACKLASH DETECTION OF TWO-MASS ROTATIONAL SYSTEM USING ARTIFICIAL NEURAL NETWORK (ANN)

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Thesis is submitted in fulfillment of the requirements for the degree of

Bachelor of Engineering (Hons.) Electronics Engineering

Faculty of Electrical Engineering

JANUARY 2018

ACKNOWLEDGEMENTS

In the name of Allah, Most Gracious, Most Merciful, Who had bestowed me a knowledge, patience, and strength in completing my thesis for Final Year Project (FYP 2). I would also like to express my deepest and sincerest appreciation to Madam A'zraa Afhzan AB. Rahim, my supervisor for this course of practical training, who has supervised me tolerantly and patiently by providing valuable guidance, advice, support as well as motivation from the very beginning until the completion of this study.

Without her insightful suggestions and his dedication to guiding me, this report would not have come to completion in such a timely and professional manner. Her enthusiasm and encouragement for this study had helped me to a great extent towards completing this report.

Special thanks to my parents for their continuous supports either emotionally or financially in which I believe that the study will not come into completion without them. I would also like to express a heartfelt appreciation to my friends for keep supporting me by sharing more knowledge and guidelines to ensure that I am able to complete the report excellently.

ABSTRACT

In this study, NFTOOL with Levenberg-Marquardt (trainlm) algorithm has been used to detect the presence of backlash in a vehicle driveline system model. The database consists of data with and without backlash that was collected from ECP Model 220 industrial plant emulator. The same data was first filtered using a Butterworth filter then was used as input and target to develop ANN models. The model was trained, tested and validated using MATLAB R2013a software. The result was analyzed based on the mean square error (MSE) and regression (R) values. MSE and R value is obtained for different sampling time and compared. It was found that MSE value for dataset without backlash is smaller than dataset with backlash. While R value for dataset without backlash is better than dataset with backlash.

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CHAPTER 1

INTRODUCTION

1.1 BACKGROUND OF STUDY

In vehicle driveline system, backlash is one of the problems that can reduce driveability. It can also limit the performance of speed and position of the driveline system. In reality, backlash occurs in a mechanical system where the driving motor indirectly connected to the driven load. As stated in [1], the identification of backlash and control of backlash is an important topic which is dealt with from the 1940s.

Vehicle driveline system was modeled as two mass rotational system using ECP Model 220 industrial plant emulator in [2]. This model has two disks which are drive disk and load disk. There are a few papers dealing with the identification and control of a two-mass rotational system that mainly considers the oscillation of the drive in [3],[4] and [5]. According to these studies, "shunt and shuffle" are backlash phenomena. The shunt can be described by the transient torque after the backlash traversal, while shuffle can be described as the oscillation in the traversing of driveshaft torque of the vehicle. These phenomena occur at the pedal tip in and tip out, where the driver quickly depresses the accelerator pedal reported in [6] and [7]. Furthermore, researchers in [8] have proposed two methods to identify backlash without an output position sensor. The first method is based on dynamic reaction to a very small torque impulse produced by the motor at