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PERFORMANCE ANALYSIS FOR STABILIZING THE INVERTED PENDULUM SYSTEM USING LINEAR QUADRATIC REGULATOR AND FUZZY LOGIC CONTROLLER

MOHAMAD SYAFIQ BIN MOHD ARIF

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ABSTRACT

The inverted pendulum is a system that is not stable and require appropriate controllers to be stable. Inverted pendulum is referred by the researchers in control system engineering field for implementing various control theories. So, in this project the implementation of two controllers, Fuzzy Logic Controller (FLC) and Linear Quadratic Regulator (LQR) are studied to stabilize the inverted pendulum. This study focused on the 2 degree of freedom of inverted pendulum system using simulation of MATLAB Simulink. The development of both controllers are based on the transfer function and state space of inverted pendulum system developed by previous studies. The results of the analysis shows that both controllers could stabilize the inverted pendulum. But, the LQR controllers has the best response and better performance compared to FLC. So, based on this study the LQR controller is more suitable to be implemented with inverted pendulum in order to stabilize it.

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CHAPTER 1

INTRODUCTION

1.1 Background of Study

Inverted pendulum can be considered as an unstable system where some conditions need to be met to obtain stability through appropriate controllers. The inverted pendulum is often regarded as a widespread control problem for researchers in the control system engineering field [1] and it is a benchmark for implementing various control theories [2]. The inverted pendulum normally known as a system of single input and multiple output (SIMO) where the force applied to the cart is the input whereas the output are cart's position and pendulum's angle. In order to make the pendulum always in its inverted position, the cart's position must be handled [3]. Basically, the inverted pendulum concept is widely used for rocket launching, high precision robotic weapons and landing of aircrafts [4-5].

The inverted pendulum control comprises of swing-up, stabilization, and tracking control. The stabilization and tracking control are more practical in application of the inverted pendulum. The control task became more difficult as the inverted pendulum is a naturally unstable system and highly nonlinear dynamics for open loop and closed loop.