Gantry Crane System Using Real Time Command Shaping

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This report is submitted in partial fulfillment of the requirements for award of Bachelor of Electronic Engineering (Industrial Electronics) With Honours

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Universiti Teknikal Malaysia Melaka

April 2010

UNIVERSTI TEKNIKAL MALAYSIA MELAKA
FAKULTI KEJURUTERAAN ELEKTRONIK DAN KEJURUTERAAN KOMPUTER

BORANG PENGESAHAN STATUS LAPORAN
PROJEK SARJANA MUDA II

Tajuk Projek : Gantry Crane System Using Real Time Command Shaping

Sesi Pengajian : 2009/2010

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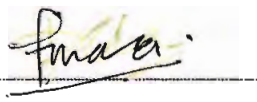
Signature : 

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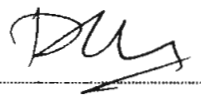
Signature : 

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Dedicated to my beloved family especially my father and mother, lecturer, and also to all my friends

ACKNOWLEDGEMENT

First and foremost, I would like to praise God for His blessing. He gave me physical and mental strength to carry on my final year project up to completion.

I would like to express gratitude and thanks to my supervisor, Mdm. Azdiana Binti Md Yusof for her support and unfailing patience throughout the duration of the project. Her encouragement and guidance are truly appreciated. Otherwise, this project has not been possible.

Other than that, I am also grateful to my all friends who help me and giving me opinion along implementation of this project.

I would like to thanks my parent on their moral support as I can count on them whenever I am upset or down.

Finally, I would like to offer thanks and deepest gratitude from the bottom of my heart for all the support, encouragement and inspirations I obtained throughout the duration of this project. The help rendered to me priceless, be it from the smallest of its kind to the largest.

ABSTRAK

Comand Shaping teknik adalah satu teknik yang digunakan untuk mengawal ayunan dan getaran yang terhasil semasa kren membawa suatu beban dari satu tempat ke tempat yang lain. Projek ini akan menumpukan tentang teknik *command shaping* untuk mengawal getaran dan ayunan. *Simulink* digunakan untuk mengkaji sifat-sifat dinamik kren *gantry*. Simulasi ini telah menunjukkan bahawa pergerakan beban dan troli akan menjadi tidak stabil dengan kewujudan getaran dan ayunan. Sistem kren akan menjadi sistem tak teredam apabila daya yang dikenakan ke atas kren diberhentikan. Sistem kren akan mengayun dengan pelbagai frekuensi dalam situasi ini. Cabaran projek ini adalah untuk membentuk satu sistem kawalan untuk sistem kren *gantry* yang dapat mengurangkan ayunan atau getaran beban dan tali. *LabVIEW* digunakan sebagai aturcara bergrafik untuk teknik mengesan getaran dan ayunan dan memberi tindak balas untuk mengurang atau mengawal ayunan beban yang dibawa oleh kren. Projek ini telah mengkaji prestasi sistem kawalan yang diperkenalkan ini. Dengan kehadiran sistem kawalan ini, sistem kren *gantry* akan berupaya untuk menghantar beban ke destinasinya dengan selamat dan pantas dan pada masa yang sama getaran dan ayunan beban adalah yang paling minima dalam proses pergerakan ini.

ABSTRACT

Command shaping technique is one of the technique that have been used to control the vibration and swing that has been produced while the crane bring the load from one place to another. This project will focus on command shaping technique to control vibration and swing. Simulink software is used to analyze the characteristics of the dynamic gantry crane. This simulation show that the load movement and the trolley will be unstable with the vibration and swing. In this situation, the crane system will swing with various frequency. The challenge of the project is to build one control system that can reduce the load and cable vibration and swing for the gantry crane. The LabVIEW is used to show the technique in sensing the vibration and swing. Plus, it also give the feedback to trolley for reducing and controlling the load. This project had studied the performance of this designed controller in the crane system. With this controller the gantry crane system is able to transfer the load from point to point as fast as possible and safety, at the same time, the load swing is kept small during the transfer process and completely vanishes at the load destination.

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CHAPTER I

INTRODUCTION

1.1 Overview

As we all know, cranes are widely used at industry such as for transportation of heavy material in factories, warehouse, shipping yards, building construction and nuclear facilities. Because of that, cranes have very strong structures.

Crane system is tends to be highly flexible in nature, generally responding to commanded motion with oscillations of the payload and hook. The response of this system to external disturbances such as wind is also oscillatory in nature. The swaying phenomenon introduce not only reduce the efficiency of the crane, but also cause safety problem in the complicated working environment.

Previously, all the cranes were manually operated. But manual operation became difficult when cranes became larger, faster and higher. Due to this, efficient controllers are applied into the cranes system to guarantee fast turn over time and to meet safety requirement.

1.2 Project Objective

The main objective of this project is to design a gantry crane using real time command shaping by developing a systematic methodology to control and minimize residual vibration and sway angle.

1.3 Problem Statement

Currently, the are some often cases like accident to human cause when crane transfer payload from one part to another part at industry. That is not only cause an accident but damaged the payload. These happen because when the payload is transfer from one part to another part using gantry crane system, the payload is vibrate and swing.

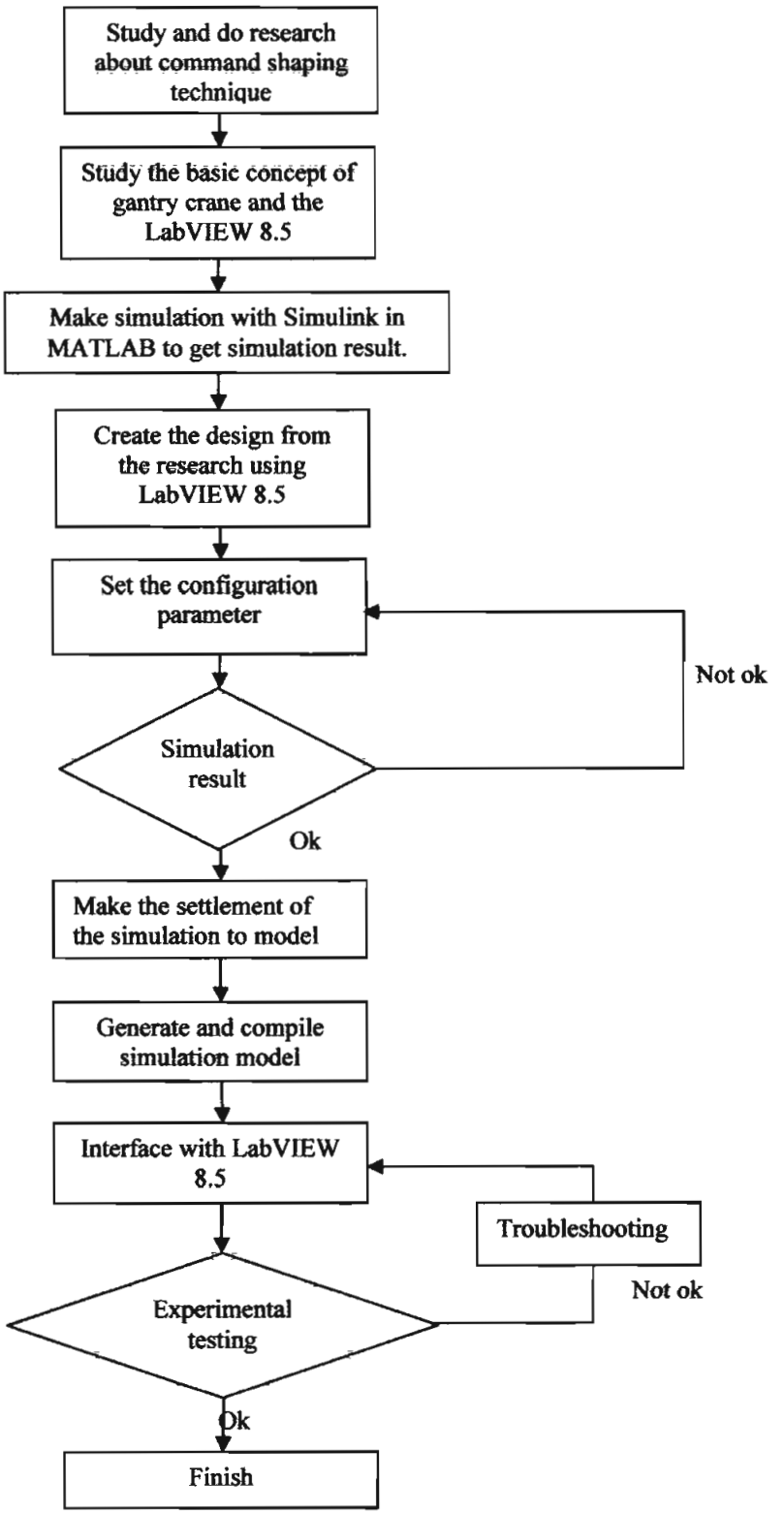
In this case, command shaping technique will be applied to the gantry crane system to reduce vibration and swing angle at payload. This technique can make the system more stable.

1.4 Project Scope

The scopes of this project are:

i. Research and study about command shaping technique.
ii. Study the modeling of a gantry crane system.
iii. Study on real time command shaping to get the output for gantry crane system.
iv. Learn more specific about Simulink in the MATLAB.
v. Simulate and investigate the dynamic performance of the gantry crane system.
vi. Study on LabVIEW 8.5 to develop controller and to detect and control the vibration and sway angle using DAQ card.
vii. Apply the technique to the gantry crane, testing and troubleshooting.

1.5 Project Methodology



1.6 Thesis Outline

In this thesis will describe about the command shaping technique to minimize and reduce vibration on gantry crane system when the gantry crane bring payload from one point to another point. This thesis has six chapters. First chapter describe about briefly introduction about this project such as objective of the project, problem statement and scope of this project. On the second chapter will describe about literature review of recent work to develop this project. Research methodology about real time command shaping, illumination about PID controller and LabVIEW 8.5 software is state in chapter three. Chapter four is about simulation result, discussion and analysis of the result. Hardware interfacing about this project will be described in chapter five. Lastly, chapter six is about conclusion and recommendation about this project.

CHAPTER II

LITERATURE REVIEW

This chapter consists of some information about crane system and also an overview of the literature that has been published in relation to crane control.

2.1 Type of Crane

A crane consists of a hoisting mechanism such as hook and a support mechanism such as trolley girder. The hoisting mechanism has two main functions. It deposits the payload at the target destination and avoids the obstacle in the path by lifts and lowers the payload. The function of the support mechanism is moves the suspension point around the crane workspace.

Crane can be classified based on the degree of freedom the support mechanism offer the suspension point. There are three major types of crane system:

(a) Gantry (overhead) crane

(b) Rotary (tower) crane

(c) Boom crane.

2.1.1 Gantry Crane

Both overhead travelling cranes and gantry cranes are types of crane which lift objects by a hoist which is fitted in a trolley and can move horizontally on a rail or pair of rails fitted under a beam. An overhead travelling crane, also known as an overhead crane or as a suspended crane, has the ends of the supporting beam resting on wheels running on rails at high level, usually on the parallel side walls of a factory or similar large industrial building, so that the whole crane can move the length of the building while the hoist can be moved to and from across the width of the building.

A gantry crane or portal crane has a similar mechanism supported by uprights, usually with wheels at the foot of the uprights allowing the whole crane to traverse. Some portal cranes may have only a fixed gantry, particularly when they are lifting loads such as railway cargoes that are already easily moved beneath them.

Figure 2.1 shows the example of gantry crane that used in industry.

Figure 2.1: Gantry Crane