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THE MATHAMATICAL ANALYSIS OF THE HOIST MOTOR SPEED CONTROL OF THE TRANSTAINER IN SRI LANKA PORTS AUTHORITY

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

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by

S.K.F.RODRIGO

Supervised by : Dr. Thrishantha Nanayakkara

Department of Electrical Engineering
University of Moratuwa, Sri Lanka

University of Moratuwa
86327

January, 2006

86327

86327

DECLARATION

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

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

UOM Verified Signature

S.K.F.Rodrigo
23 Jan 2006

We/ I endorse the declaration by the candidate.

UOM Verified Signature

Dr. Thrishantha Nanayakkara

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Abstract

This research is based on the mathematical analysis of the speed control of the Hoist Motor installed in the Transtainer, Sri Lanka Ports Authority.

The Transtainer is a crane used for the handling of containers and the Hoist Motor installed in the transtainer is used for the lifting and lowering of the containers from the container vessel to the container yard or vice versa.

This analysis has been done for the hoist operation of the transtainer. The hoisting speed is started from the zero speed and reached to a steady speed after the acceleration is finished and finally, it is reached to the zero speed again. This complete cycle is known as the hoist operation.

A separately excited DC motor is used for the Hoist Motor to lift a container load. The operator of the transtainer uses the joystick controller having five notch positions to control the speed of the hoist motor and when the operator uses the joystick controller from zero to fourth notch, the speed varies from zero up to the base speed and when the joystick controller is put from fourth notch position to fifth notch position, the speed of the motor is varied from the base speed to the final steady state speed which is higher than the base speed. This final speed depends on the container load which is lifted by the hoist motor.

The Hoist Motor speed is controlled from zero up to the base speed by changing the armature voltage of the motor and the motor speed is controlled from base speed up to the final speed by changing the motor field current.

The armature voltage of the hoist motor is controlled by changing the DC generator out put voltage which is directly supplied to the hoist motor.

The out put voltage of the DC generator is controlled by changing the generator field current which is controlled by the firing signals of the thyristors. Firing signals of the thyristios are controlled by the speed controller mainly consisting of Automatic Speed Regulator (ASR) and Automatic Current Regulator (ACR).

The speed reference signal produced by the joystick controller in the crane is given to the speed controller via a soft starter and this speed reference input to the speed controller is a ramp signal. In addition to the speed reference input, the armature current feedback and the motor speed feed back are given to the speed controller to control the motor speed.

In this research, two mathematical models were made to analyse the motor armature voltage control and the motor field control and the both transient and steady state analysis of the hoist motor speed have been done in addition to the stability analysis.

Contents

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List of Figures

List of Tables