

**REAL TIME KNOWLEDGE BASED
SUPERVISORY CONTROL
OF
AC DRIVES**

By

M. SRINIVASA RAO

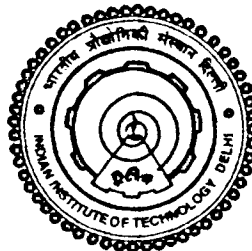
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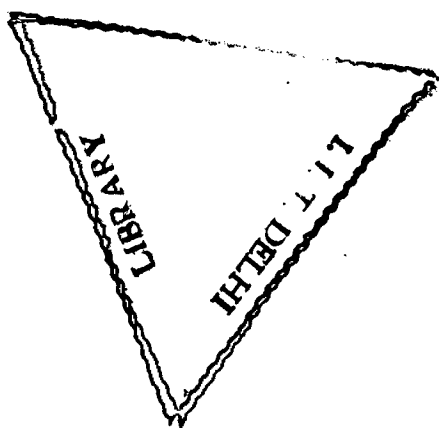
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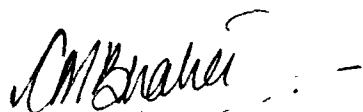
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CERTIFICATE

This is to certify that the thesis entitled **REAL TIME KNOWLEDGE BASED SUPERVISORY CONTROL OF AC DRIVES** being submitted by **M.Srinivasa Rao** for the award of degree of "**DOCTOR OF PHILOSOPHY**" to the **INDIAN INSTITUTE OF TECHNOLOGY, DELHI** is a record of the bonafide research work carried out by him under our joint supervision. The results contained in this thesis have not been submitted in part or full to any other University or Institute for the award of a degree or diploma.



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ABSTRACT

This thesis presents the theoretical as well as experimental investigations carried out in the design and development of a simple, flexible, and highly cost effective system for a scalar controlled induction motor drive and also examines their effectiveness, with a view to identifying an appropriate speed controller for a given application. This thesis also presents the investigations made in design and development of a knowledge based supervisory controlled multi AC drive system by integrating the concepts and technology available in four major topics e.g. knowledge based systems, control theory, computer communications and variable speed drives.

The design and development of IGBT/BJT based PWM voltage source inverter power circuits with various protection schemes and their elaborate testing procedures, using novel PWM waveform generation circuit board, input/ output interfacing circuits, data acquisition systems are also carried out, investigated and reported. A multi AC drive pilot plant with four voltage source PWM inverters is developed in the laboratory for carrying out various investigations reported in this thesis.

Further, the design, development and implementation of real time star connected serial communication network with communication link failure and detection algorithms have been done to provide a reliable communication link between the supervisory computer and the local operator controllers. Further, the Supervisory Control And Data Acquisition (SCADA) software is specially designed and developed in the laboratory and is interfaced with the PWM inverters for controlling the multi AC drive pilot plant.

Real time system simulation studies have also been conducted on a three-phase inverter fed induction motor using *MATLAB*, *SIMULINK*, Fuzzy Logic Toolbox and *PSPICE* packages around Personal Computer environment. The steady-state and transient response at different operating conditions like starting, step speed variations, speed reversals, change over of load between inverters under fault conditions and sequential drive operations have been studied and the results obtained are compared with those obtained through experimental investigations on the developed prototype pilot plant with a view to study and compare the performance of the real system with that of the simulated system.

Three different speed controllers e.g. conventional controller, Fuzzy logic controller and heterogeneous Fuzzy logic controller are used in the simulation studies of the AC drive system so as to identify an appropriate speed controller for a given application.

Simulation studies on inverter fed drive system are also conducted for different fault conditions like one phase shorted to ground, one phase open (single-phasing), line-to-line short, three-phase shorted to ground, three-phase open (sudden power interruption) to study the drive performance. Gate drive and base drive circuits, protection circuits and power circuits have also been simulated using *PSPICE* under the steady-state and transient conditions. Based on the simulation results thus obtained, the prototype circuit boards have been designed developed and tested individually, before they are interfaced to the multidrive system pilot plant.

Successful experimental results have also been obtained using the newly developed novel and versatile PWM waveform generation circuit board using MA818 controller in conjunction with the eight bit microcontroller and personal computer, to demonstrate the performance and control capability of the multidrive system. The practical results thus obtained on the newly developed pilot plant are compared with the real time simulation results and are discussed in detail case by case. Further enhancement of the system performance and extension of this research work to other tasks has also been reported in this thesis.

It is hoped that the theoretical and experimental investigations reported in this thesis will pave the way for the design and development of a versatile and cost effective variable speed general purpose scalar control AC drive system.

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