ABSTRACT

A Generalized System With Applications

In Electrical Engineering

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The increasing power of personal computers, their decreasing costs and the accompanying wide array of software commercially available for data acquisition, display, processing and analysis, make a data-acquisition and control system based on a personal computer a powerful tool for teaching and research in electrical engineering.

This thesis documents the work done on the design and development of a novel multi-purpose, computer-controlled system with a graphical user interface to enable users to observe, record and simulate the behavior, under steady-state or dynamic conditions, of electrical power converters, transformers, machines and drives. The system comprises a personal computer, a data acquisition system and one or more micro-processor-controlled power conversion modules containing two three-phase bridge converters connected in anti-parallel which use mosfet switches, and is well-protected from improper operation due to human error, faults in the software or hardware, including the personal computer and the power supply.

Digital patterns applied to the mosfets enable the application of line- or forced-commutation and determine the topology and mode of operation of the bridges in the power conversion module and its output. This method of control enables the application from the personal computer of control techniques such as PID and software processing, which are readily available for use with personal computers.

Using artificial neural networks and data acquired from electrical machines and transformers while they are in operation, models may be created to simulate these devices in Spice.

The motivation for this project was the need to make instruction and research simpler, quicker and more efficient in the electrical energy systems laboratory. With this system, it will be possible to quickly set up for demonstration and study many experiments with electrical power converters, transformers, machines and drives. Experiments, normally impossible because of their complexity and the length of time required to perform them, can be carried out, and more time will be available for users to, with little supervision, probe deeper and acquire a more thorough understanding of the engineering principles on which the exercises are based.

Keywords: John D. C. Joseph; generalized machine; electrical machines; synchronous machines; dc machines; induction machines; electrical drives; power electronics; simulation; Matlab; PSpice; artificial neural networks.