

# MODELING AND CONTROL DESIGN OF VSI-FED PMSM DRIVE

## SYSTEMS WITH ACTIVE LOAD

by

Zoran Mihailovic  
Dr. Dushan Boroyevich, Chairman  
Electrical Engineering

### ABSTRACT

A field-oriented control design and detailed analysis of a VSI-fed PMSM drive system with active load is done through simulations of the system model, using modern simulation software packages. A new control method for the speed tracking control based on the estimation of the load torque profile is proposed.

A new, multilevel modeling approach for creating simulation models of power electronic circuits is developed for easier analysis and faster simulations. It is based on a modular approach wherein each module can be modeled at any level of complexity, while maintaining full compatibility of the modules.

The new approach is applied to modeling of the VSI-fed PMSM drive system. The three-phase VSI-fed PMSM drive system model that is developed and experimentally verified is analyzed in the application of a starter/generator, where the load changes dynamically with motor speed. As a result, a detailed analysis of the field-oriented control design of a two stage cascade digital controller is presented, with an emphasis on the new method for the speed control, large-signal and small-signal analyses of several most popular flux-weakening strategies, and sampling delay effects on the system stability.