

FE-based Physical Phase Variable Model of PM Synchronous Machines with Stator Winding Short Circuit Fault

Osama A. Mohammed, Fellow IEEE, S. Liu, and Z. Liu
Power Systems Laboratory, ECE Department, Florida International University

Modeling of electrical machines under internal fault condition is necessary for tolerant control and drive turning strategy development. It is also necessary for the fault diagnosis of power systems as well as optimization issues. Previous works indicate that the modified winding theory and the full FE modelling are two major methods used for such a purpose. The deficiency of the winding theory method is its physical inaccuracy. The drawback of the full FE modelling is its long computation time.

A FE-based physical phase variable model of machines with internal winding fault is proposed here for the first time. This method achieves an accurate modelling and fast simulation speed. The parameters required in the FE-based model are obtained from circuit-field coupled FE analysis of the machines under fault conditions. As an example, a PM synchronous machine with stator winding short circuit fault is presented. The corresponding phase variable description is given. The procedure of performing coupled FE analysis for simulating the short circuit fault is described and the parameters calculated from FE solutions is provided. Moreover, Simulink implementation of the proposed model as well as its verification is presented. This is done by comparing the electrical and mechanical properties of the developed FE-based model with those given by the full FE model. The significance of this work is that it introduces a feasible procedure to establish a physically accurate and computationally fast phase variable model of machines under internal winding fault conditions.

Contact information of the corresponding author:

Professor O. A. Mohammed
Department of Electrical & Computer Engineering
Florida International University
10555 W. Flagler Street
Room EC-3983
Miami, FL 33174
Tel: (305) 348-3040
Fax: (305) 348-3707
e-mail: mohammed@fiu.edu

Topic: applications of computational electromagnetic