Induction Machine Model for Fault Diagnosis using Hardware in the Loop and Finite Element Analysis

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ABSTRACT

Induction machines are the workhorse of modern industrial equipment, so that its maintenance is a key factor in industrial productivity. Non-invasive, on-line assessment of the motor condition can nowadays detect and identify motor faults in an early stage, before an unexpected shutdown of the production line, which can be very costly in time and resources. However, accurate models of the induction machine are needed to develop and test fault diagnostic methods, such as motor current signature analysis (MCSA), both in steady state regime and under transient regime. Besides, these models must be run in real time in order to develop diagnostic algorithms using digital signal processors (DSPs) or field programmable gate arrays (FPGAs). But both requirements are in conflict. The most accurate methods, such as those based on finite elements analysis (FEA), require a high computing power and long running times, from minutes to days in the case of highly asymmetrical faults such as mixed eccentricity or broken bars. On the contrary, hardware in the loop (HIL) systems are able to run machine models in real time, but are limited to simple, analytical models, and cannot run FEA models. In this paper, a new approach is presented to address this problem. It is based on an OPAL-RT HIL simulator, running an analytical model made with MATLAB-Simulink, but the inductances matrix of the model has been derived through the FEA analysis of the motor for every rotor position, taking into account the asymmetries induced by the fault. In this way, a real-time simulation of an accurate model of the motor under faulty conditions has been built and has been applied to the development of diagnostic algorithms.

REFERENCES

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