Dynamic Braking: A new approach for testing Electrical Machines.

Abstract

In this thesis, a novel method for characterizing Permanent Magnet Synchronous Machines (PMSMs) based in the dynamic response of the analyzed motor is evaluated. The most significant motor characteristics -torque, flux and efficiency maps- are computed from the motor voltage, currents and rotor position data sampled during the experiment. This way of obtaining the characteristics of the motor is possible thanks to the use of new data acquisition equipment based on Field-Programmable Gate Arrays (FPGAs) with sampling frequencies up to MHz, which make possible to calculate the transient state, and not only the steady state data.

Among the advantages of the evaluated method is that there is no need to couple the test motor to either a torque measurement device or a braking motor, which reduces both the required size of the lab and the costs of the test. Moreover, the whole test sequence is completely automated as well as the post-processing of the experimental results, and it is all conducted within a few minutes, avoiding the drift in the results originated from the variation of temperature and other external conditions.

First in this work, a simulation model of the complete test is developed in Simulink, in order to validate the test protocol. Subsequently, the method is applied to a real Permanent Magnet Synchronous Motor (PMSM) of known characteristics, in order to evaluate the performance of the proposed method in relation to more traditional ways of testing electrical machines. .

When compared to the available motor characteristics, the torque and flux maps obtained with the suggested test method exhibit smoother curves, due mostly to the higher sampling frequency and accuracy of the new data acquisition process. In addition, the matching between the newly obtained motor characteristics and those already available is remarkable, and the slight differences that appear can be explained by the different evolution of the motor temperature (particularly the rotor magnets' temperature) throughout the test for the two methods considered. In conclusion, the results presented in this thesis work prove that the evaluated method is suitable for characterizing electrical machines.