A New Experimental Setup for Electric Motor Drives Laboratory with Mechanical Load Simulator

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***Abstract*—In this paper, a new experimental setup for electric motor drive systems laboratory which acts as a simulator for several real-world mechanical loads is presented. The experimental setup contains two three-phase AC electrical machines which are coupled via their shafts, off-the-shelf motor drive units, transducers and data acquisition system, and a control system constructed on Labview. One machine which is a permanent magnet synchronous machine (PMSM) is used as a generator under torque control to simulate various mechanical load characteristics changing with speed while the other one which is a three-phase induction machine is operated as the motor to be driven by speed control. The main purpose of the experiment is to enable students who are 4th year undergraduates to implement speed control for induction motors and analyze the behaviour and characteristics of the motor and the drive while the motor is subjected to different real-world mechanical loads which are difficult and expensive to build in a laboratory such as fan load, pump load, electric traction system etc. During the experiment, the students can observe variation of mechanical output torque, applied voltage and frequency, active and reactive power, efficiency as well as the effects of the motor drive to grid power quality and motor insulation under these load conditions and make interpretations accordingly.**

***Index Terms*—electric motor drives, electrical engineering education, laboratory experiments, mechanical load simulator.**

I. Introduction

THE key part of an electric motor drive course laboratory is real-world mechanical loads.

II. Background of the Electric Motor Drives Course

III. The Experimental Setup

The experimental setup installed in Middle East Technical University Electrical Machinery Laboratory is shown in figure 1. As the block diagram of the setup at figure 2 illustrates, the test bench is consist of two electrical machines coupled to each other; an squirrel cage induction machine and a permanent magnet synchronous machine. The IM is supplied through an AC variable frequency drive connected to the grid. The PMSM is drove by a back-to-back AC-DC-AC converter which is also connected to the grid. The back-to-back power converter provides the ability of the two direction power flow to develop a variety of experiments on the setup. In order to control and monitor the experiment flow LABVIEW interface environment is used on the computer; a supervisory control and data acquisition program provided by National Instruments. An Ethernet connection is used to build a data communication between computer and the drives. The AC drives can be drove with torque or speed reference commands sent by operator of the experiment using the interface program. On the other side, during the experiment a set of data is measured and transmitted to the interface program. A torque transducer placed at the coupling point of IM and PMSM measures and sends the applied torque on the shaft and the rotating shaft speed to the computer. LEM voltage and current transducers are used to gather the electrical variables' data to be monitored at the supplying terminals of the machines. The all data monitoring and test bench controlling job is done via a user interface program seen in figure 3. Besides a power quality analyzer is connected to the grid connection point of the drives to study the harmonic distortion and the power quality issues.

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IV. Methodology and Aims for Students

V. Results and Interpretation

VI. Conclusions

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Appendix A
Proof of the First Zonklar Equation

Appendix one text goes here.

Appendix B

Appendix two text goes here.

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Michael Shell Biography text here.

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Jane Doe Biography text here.