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Doubly fed induction machine drive distance learning laboratory for wind power and electric ship propulsion applications

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Monterery, California, Naval Postgraduate School

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Doubly Fed Induction Machine Drive Distance Learning Laboratory for Wind Power and Electric Ship Propulsion Applications

Giovanna Oriti, Alexander L. Julian, Dan Zulaica

September 17-22, 2011

Phoenix, Arizona

Naval Postgraduate School

A state of the art FPGA based Student Design Center (SDC) has been applied to Couble-Fed Induction Machine Drive Labora 🏠 • 🖾 🖃 📾 • Page • Safety • Tools • 🚱 • research and curriculum at the Naval Postgraduate School for the last five years. Doubly-Fed Induction Machine Drive Laboratory A web-interface was recently created to make the SDC available to remotely located students taking Distance Learning (DL) courses. This DL laboratory Live Webcam of Lab Setu Oscilloscon allows the remote student to experimentally verify the operation of a DFIM drive system emulating a wind power turbine connected to the grid or a bidirectional Screen drive for ship propulsion applications. Capture The power electronics is controlled by two FPGA based controllers which of the communicate with a web server PC through a USB interface so that the Lab laboratory can be executed on campus as well as remotely. The remote students Graphic only need access to a PC with internet connection and a standard browser, User without the need to install any software or modify its security settings. Interface in a Interface PCB Functionality standard 4 currents Web A/D converters Sensors 3 voltages 161 V O-Browser IC firs Vall FPGA/USB Web USB connector **Block** Xilinx Interface chip Change DFIM Spe Change Input Torou Server 1440 rpm 60% Virtex 4 **Diagram of** Encoder pin TTL connector **FPGA** the Board Embedded Load and IGBT External Integrated Power Module (IPM) Contact Lab Ter cian for assistance **Electronics** Components in the SDC Web Serve ±15V 5V **Diode rectifier** AC power 5V USB AC-DC Oscilloscone 36 or single 6 chd Conversion Xilinx XC4VLX25 FPGA Xilinx XC4VLX25 FPGA Roto Custom interface Laboratory Experiment Using SDC2 PCB with A/D Web Server Custom interface Currents Stator H converters and USB card card voltages Java interface (top) (A/D converters FTDI The other devices (A/D converters Stator serve FPGA board with and digital I/O in the Experiment API and digital I/O engine USB interface A++ A + B++ B + C++ C+ HTML wrapper using FPG4 Web Video/audio Oscilloscope with Client embedded web pages tabs and iframes How the Lab is Web Gateway/firewall Video Standard browser Made Vher Server ports **Available** 3
Input DFIM Stator 4 poles internet to connecte to grid Gateway/firewall Gateway/firewall Input torque Remote Standard browser Standard browser ports ports PCB with Students IGBT IPM module Remote user Remote user Remote use 3 phase AC grid with with with Web browser Web browser Web browse SDC Hardware in the Lab **DFIM Drive as Implemented in the Lab**