Guest Editorial

THE USE of doubly fed induction machines (DFIMs) dates back to Scherbius and Kramer drives. Both of these concepts in their original forms required additional electric machines. The fundamental difference is that the Kramer drive deals with power in both mechanical and electrical forms, whereas the Scherbius drive processes power only in electrical form. Obviously, these drives are only used for multimegawatt system, where the cost of additional machine is justified.

DFIMs have slip rings and brushes in the rotor side. These make such machines less rugged as compared to the machine with a squirrel-cage rotor. However, such structural difference also brings in additional degrees of freedom in the control of such machines. The rotor winding needs to take care of only a fraction of total power output/input. Moreover, given recent developments in low-cost power devices and controllers (such as DSP/field programmable gate arrays), a static Scherbius drive has emerged as a potential alternative in many high-power systems. Both direct conversion using cycloconverters or matrix converters and indirect conversion using back-to-back voltage-source inverters (VSIs) are reported. The DFIM as a generator [i.e., double-fed induction generator (DFIG)] has recently become very popular in wind–electric power conversion systems that require variable-speed and constant-frequency drive to maximize the wind-energy capture. Several areas are the challenges at present, including as follows: 1) active–reactive power control; 2) extension of the operating speed range; 3) fault-tolerant operation, etc.

This "Special Section on Application and Control of Doubly Fed Induction machines" aims to generate more interest on the investigation of the DFIM and also to focus on some of the existing challenges. The Guest Editors first organized a Special Session at the IEEE International Symposium on Industrial Electronics (ISIE08) in Cambridge, U.K. A general Call for Papers was announced following the conference. We received a total of 26 papers of which 11 papers were finally accepted and included in this Special Section. These papers are presented in three different categories: 1) performance of DFIM drive; 2) different options of brushless mode of operations; and 3) fault-tolerant control.

The first six papers deal with improving the performance of the DFIM drive. While all six papers consider a topology where the converter is put in the rotor side and the stator is directly connected to the grid, the first four papers consider the back-to-back VSI in the rotor side, whereas the last two papers replace the VSIs by a matrix converter. In the first paper, Xu *et al.* propose a predictive-control technique to estimate the rotor-current variations in the stator-flux-oriented reference frame, which is used to calculate the rotor voltages and hence eliminate the current errors in the following sampling period. Control of active and reactive powers is extremely important in DFIGs. The active power regulates the frequency while the reactive power controls the voltage. A decoupled control of active and reactive powers is presented in the second paper by Rabelo *et al.* The third paper by Arbi *et al.* deals with a technique for fast and smooth connection of the generator to the grid using rotor flux and virtual flux. The technique only requires the measurement of grid voltages, and rotor current and position. Forchetti *et al.* in the fourth paper reported an adaptive observer for the sensorless control of a stand-alone DFIG. An adaptive Luenberger observer is used for the estimation of stator flux and rotor position. The performance of a matrix converter in the rotor circuit of the DFIG is presented by Pena *et al.* in the fifth paper while a detailed study of the stability of such system is reported by Cardenas *et al.* in the sixth paper.

The second group of papers involves different configurations of doubly fed systems. The first paper in this category is by Patin *et al.*, who proposed a cascaded DFIM for stand-alone generating systems. The system is modeled in detail; simulated and preliminary experimental results are added to validate the configuration. The second paper by Shao *et al.* has reported a stator-flux-oriented control of the brushless DFIG, where both the windings are placed in the stator side; the main winding being directly connected to the grid and the second winding interfaced through a converter-inverter set. Owing to increased mechanical ruggedness, such a system has high potentiality for wind-power extraction systems.

The third and last category of papers deals with fault-tolerant operation of DFIG systems. Two papers by Rothenhagen and Fuchs are included in this part, which deal with fault detection, isolation, and reconfiguration. Finally, a paper by Lopez *et al.* proposes a method for enhancing the ride-through performance of a wind-turbine-driven DFIG during voltage sags.

The Guest Editors hope that the presented series of papers will be helpful to those researchers and practicing engineers who are working on DFIMs. This Special Section will be regarded as successful if these papers stimulate further interest/research in this area. In the process of preparing this Special Section, the editors received significant support from the authors and reviewers and from Prof. B. Wilamowski, the Editor-in-Chief. Their support is gratefully acknowledged. The Guest Editors would also like to thank S. McLain for her excellent management and very timely advice.

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Digital Object Identifier 10.1109/TIE.2009.2028673

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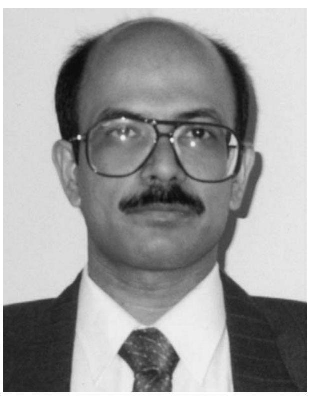

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