

A Wind Energy Conversion System Based on a Matrix Converter

Power electronic converters (PEC) are deployed in the new generation of wind energy conversion systems to improve the performance. A matrix converter (MC) is a new type of ac-to-ac converter with a full-silicon structure in a compact design. It has some outstanding merits, such as providing low-distortion sinusoidal input and output waveforms, bi-directional power flow, controllable input power factor.

In this presentation, a grid-connected wind-energy converter system including an MC is discussed. The MC is used to interface an induction generator with the grid and to control the wind turbine shaft speed. Through the MC, the terminal voltage and frequency of the induction generator are controlled to adjust the turbine shaft speed and accordingly control the active power injected into the grid to track maximum power for all wind velocities. The power factor at the interface with the grid is also controlled by the MC to either ensure purely active power injection into the grid for optimal utilization of the installed wind turbine capacity or assist in regulation of voltage at the point of connection. Furthermore, the reactive power requirements of the induction generator are satisfied by the MC to avoid use of self-excitation capacitors.

The presentation addresses two dynamic models: a comprehensive dynamic model for a matrix converter and an overall dynamical model for the proposed wind turbine system. Two control design methods are adopted for the design of the closed-loop controller: a state-feedback controller and an output feedback controller. Finally, a maximum power point tracking method, referred to as mechanical speed-sensorless power signal feedback, is developed for the wind turbine system under study to control the matrix converter control variables in order to capture the maximum wind energy without measuring the wind velocity or the turbine shaft speed.

Biography

S. Masoud Barakati received the B.Sc. degree from Ferdowsi University, Mashad, Iran, in 1993, M.Sc. from Tabriz University, Tabriz, Iran, in 1996, and the Ph.D. degree, from the University of Waterloo, Canada, in 2008, all in electrical engineering. From 1996 to 2003, he was with the department of electrical engineering, University of Sistan & Baluchestan, Iran, as a faculty member. From June 2008 to 2009 he was a postdoctoral fellow with the University of Waterloo, Canada. He is currently a research associate in the department of electrical and computer engineering, University of Wisconsin-Madison, US. His research interests include power electronics circuits, microgrids, renewal energy, power systems, and control systems.