PREDICTIVE CONTROL OF PERMANENT MAGNET SYNCHRONOUS MACHINE USED IN A WIND SYSTEM

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Abstract: The use of renewable energy systems has become very important in the re-cent years due to environmental concern and the increasing demand of energy. Nowadays, wind power is the fastest growing energy source with increase in installed power mainly driven by increase in quantity and power rating of the wind turbines. The increase in the power of the generators leads to the need of research on new control strategies and different topologies of power converters to combine performance, power quality and efficiency demanded by these sys-tems.In this sense, this research project presents various advanced predictive control strategies for different power electronic converters employed in perma-nent magnet synchronous generator (PMSG) wind energy systems. The pro-posed systems combine the advantages of proven wind turbine technologies, such as low-cost machine-side converters, and efficient grid-side converters. The classical control techniques, based on linear PI regulators and low band-width modulation, present several technical issues during system operation, to overcome these issues, a high performance predictive control strategies are proposed in this thesis to control the power converters. The main feature of these control techniques are that a particular attention is paid to increase the efficiency and sustainability, reduce the torque and DC-link ripples, operating at considerably constant switching frequency and help higher penetration of renewable fluctuating power into the grid. Detailed technical work is supported by MATLAB/SIMULINK model based simulations and validated by experi-mental work on a laboratory prototype consisting in a PMSG and power con-verters, considering the fluctuation of the wind speed.

Keywords : Permanent Magnet Synchronous Generator (PMSG), Wind energy systems, Predictive control stratigies, Experimental work