

Eccentricity Fault Diagnosis based on Wavelet Transform and Neuro-Fuzzy Inference System in Doubly-fed Induction Generator

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Abstract : The development of wind turbine system is becoming very influential, in conditions of power quality and very interesting for ecological protection. However, their potential is considerable in the world, the wind energy sources have drawn more and more attention all over the world recent years to improve the serious environment problems and deal with the shortage of fossil fuels in recent years [1]. The doubly-fed induction generator (DFIG) is one of essential part of wind turbine system and has dominated in the field of electromechanical energy conversion system because of robustness and low cost [2]. So, for a substantial profit, the diagnosis should be properly developed to ensure a production system more make safe. Production systems must be provided with reliable protection systems as any failure can lead to inevitable damage [3]. The occurrence of different faults can be completely in damage this machine type and inevitably cause the process to stop, resulting in loss of production consequently [4]. Therefore, it is necessary to develop a model machine allow to detect the presence of the faults. Wind turbine is prone many failures and because of their size and localization, it is very costly to repair or replace their component. In generally, mechanical faults are the most encountered in wind turbine systems at the gearbox. These faults can occur at the level of ball, inner and outer race bearings, and flanges of the machine shaft. In scientific research tasks shows that rotor faults are more frequent breakdowns, [5, 6]. In this paper we are interested to study the rotor eccentricity faults types [7]. The DFIG in this type of faults can be subjected to counteract between the center of rotation of the shaft and the center of the rotor resulting the oscillations in the electromagnetic torque, uneven distribution of the currents in the rotor and the unbalance of stator current. This phenomenon is called static or dynamic eccentricity, and both at the same time creates the fault mixed eccentricity, whose origin may be related to incorrect positioning of the bearings during assembly or bearing failure [8, 9].

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Several methods of diagnosis are based on spectral analysis of the electromagnetic quantities, using the magnetic flux, stator current and the neutral voltage vibration signal analysis and especially the stator current which requires only a current sensor [10, 11]. Therefore most of the recent research has been directed towards non-invasive techniques such as stator current and vibration signal analysis, motor signature analysis with wavelet transform, current envelope, Artificial Intelligence such as Neural Network, Fuzzy Logic and Fuzzy Neural Network. The analysis of the stator currents in the wavelet domain remains the most commonly used because the spectrum results contains a source of information on the majority of electrical and/or mechanical faults and magnetic properties can appear in the machine [12, 13]. The artificial intelligences based on fuzzy logic system inference, artificial neural network (ANN) or combined structure techniques of artificial neural fuzzy interference system (ANFIS) are widely used in the new monitoring [14, 15]. Therefore, in order to increase the efficiency and the reliability of the monitoring in the field of the (DFIG) supervision, the proposed technique is based on wavelet transform and Neuro-Fuzzy inference system (ANFIS). In this paper, the investment interest in wind turbine conversion system based on DFIG is presented. Then, we focus on the study of their designs and the development of a global model for doubly-fed generator in case of rotor eccentricity faults. Finally, in order to validate the considered method, the proposed model has been simulated and validated by numerical simulations using MATLAB/Simulink.