Fault Diagnosis of an Induction Generator in a Wind Energy Conversion System Using Signal Processing Techniques

Issam Attoui and Amar Omeiri

1Research Center in Industrial Technologies CRTI, Cheraga, Algeria
2Laboratory of Electrical Engineering Annaba (Laboratoire d’Électrotechnique [LEA]), Badji Mokhtar-Annaba University, Annaba, Algeria

Abstract—In this article, a contribution to fault diagnosis of an induction machine in a wind energy conversion system in closed-loop operation using a combination between short-time Fourier transform and discrete wavelet transform algorithms is proposed. An on-line fault diagnostic technique based on stator currents analysis of the squirrel-cage induction generator is proposed to detect and localize abnormal electrical conditions that indicate, or may lead to, a stator or rotor failure in a squirrel-cage induction generator. This technique also permits identification of a fault severity factor and consequently helps to determine the best choice of corrective maintenance. Furthermore, a generalized model of the squirrel-cage induction generator is used to simulate both the rotor and stator faults, taking iron losses, main flux, and cross-flux saturation into account. The efficiency of diagnostic procedure in closed-loop operation of the wind energy conversion system under non-stationary operating conditions is illustrated with simulation results.

1. INTRODUCTION

Over the past few years, the fault-diagnosis methods of electrical machines, such as the doubly fed induction machine (DFIM), squirrel-cage induction machine [1, 2], and the permanent magnet synchronous machine (PMSM) [3, 4], have been the subject of increased attention. These electrical machines can be used in almost all types of renewable energy applications [5–8]. These systems can be subjected to the unavoidable stresses, such as electrical, environmental, mechanical, and thermal stresses, which create failures in their different parts [9]. In such applications, the induction machines that operate in the self-excited mode for stand-alone applications have become popular in view of their advantages over other types of machines [10, 11]. Cost-effective and reliable maintenance of these machines is thus needed to reduce the maintenance expenses by preventing high-cost failures and unscheduled downtimes. In the other hand, the control of the terminal