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Diagnosis of Stator Turn-to-Turn Fault and Rotor Broken Bars Fault Using Neuro-Fuzzy Inference System

Merabet. Hichem
Industrial Technology Research Center (CRTI) BP 64 Cheraga, Algeria
h.merabet@csc.dz

Bahi Tahar
Electrical Department, Faculty of Science Engineering. University of Annaba, Algeria
tbahi@hotmail.com

Drici. Djalel
Industrial Technology Research Center (CRTI) BP 64 Cheraga, Algeria

J.drici@csc.dz

Abstract— **I**nduction Machines (IM) are used in many fields, such as electrical drives system and main component of any industrial area that involve production processes [1, 2]. In spite of their low cost, reliability and robustness, breakdown in electrical machines lead to failure of the entire production system which cause considerable financial losses. Consequently, early detection faults are very helpful for avoiding failure and allow minimizing the downtime [3]. Stator winding fault is one of the major faults of this machine types [4-6]. The inter-turn short circuit fault is the most common fault that can occur in the induction machines, it was referenced that about 30% to 40% of all electrical machines faults are related to stator faults inter turn fault in the stator winding, which cause a large circulation current in the shorted turns [`7, 8]. Generally the inter-turn fault is caused by mechanical stress, moisture and partial discharge, which is accelerated for electrical machines supplied by inverters. But really, as well known, the primary or the main cause of inter-turn short circuit is degradation of the winding insulation, which leads to. When an inter-turn short circuit occurs, and the big problem that the inter-turn short circuit propagate and takes a large area in the winding which effectively lead to generate; phase–ground or phase–phase faults[10].

The presence of a broken bar in the cage rotor produces a geometric and electromagnetic asymmetry in the rotor circuit, and induced currents are created in direct rotating field, another field is turning around [11].

According to the literature, there are many techniques of the detection of stator and rotor faults in electrical machines drives, especially, the methods based on time domain or frequency domain techniques, which have been proposed to detect stator failures. A more intensive research efforts have been focused on frequency signature analysis for stator and rotor faults using different signals such as; machine currents, the motor current signature analysis (MCSA) combined with wavelet, wavelet

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transform (WT) applied to different signals, current envelope (CE), extended Park's vector approach (EPVA), instantaneous power signature analysis (IPSA), Short-Time Fourier Transform (STFT), support victor machine (SVM), etc, [12-15].

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 techniques of induction machines [16, 17].

Therefore, in order to increase the efficiency and the reliability of the monitoring in the field of the (IM) supervision, the proposed technique is based on Neuro-Fuzzy inference system (ANFIS).

In the aim to analyzing the faults, the global mathematical model of induction machine is developed and simulated via software *MATLAB® SIMULINK*.

Keywords— Induction Machine, Diagnosis, Detection,* Neuro-Fuzzy inference system, *Modeling, Simulation.

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