Stator winding fault detection and classification in three-phase induction motor

ABSTRACT

Induction motors (IMs) are the workhorse of the industry and are subjected to a harsh environment. Due to their operating conditions, they are exposed to different kinds of unavoidable faults that lead to unscheduled downtimes and losses. These faults may be detected early through predictive maintenance (i.e., deployment of condition monitoring systems). Motor current signature analysis (MCSA) is the most widely used technique to detect various faults in industrial motors. The stator winding faults (SWF) are one of the major faults. In this paper, we present an induction motor fault detection and identification system using signal processing techniques such as fast Fourier transform (FFT), short-time Fourier transform (STFT), and continuous wavelet transform (CWT). A three-phase motor model is developed in MATLAB Simulink and simulated under various fault conditions. The current signature is observed using FFT, spectrogram, and scalogram to detect the faults. It is observed that under some fault conditions, the current signature analysis remains indistinguishable from the non-fault case. Therefore, deep learning (DL) methods are adopted here to identify these faults. The time-series data of healthy and unhealthy conditions are obtained from the simulation results. The comparative investigation among DL models confirmed the superiority of the long short-term memory (LSTM) model, which achieved 97.87% accuracy in identifying the individual faults.