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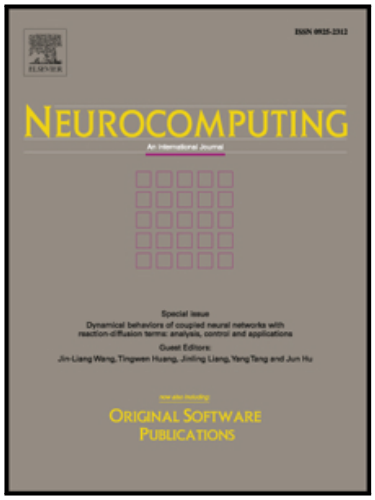

Open-Circuit Fault Diagnosis of Power Rectifier using Sparse Autoencoder based Deep Neural Network

Lin Xu, Maoyong Cao, Baoye Song, Jiansheng Zhang, Yurong Liu, Fuad E. Alsaadi

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Open-Circuit Fault Diagnosis of Power Rectifier using Sparse Autoencoder based Deep Neural Network

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Abstract

This paper is concerned with the open-circuit fault diagnosis of phase-controlled three-phase full-bridge rectifier by using a sparse autoencoder-based deep neural network (SAE-based DNN). Firstly, some preliminaries on SAE-based DNN are briefly introduced to automatically learn the representative fault features from the raw fault signals. Then, a novel strategy is developed to design the structure of the SAE-based DNN, by which the depth and hidden neurons of the SAE-based DNN could be regularly determined to extract the features of input signals. Furthermore, the fault model and system framework are presented to diagnose the open-circuit fault of the three-phase full-bridge rectifier. Finally, the effectiveness of the developed novel strategy is verified by the results of simulation experiments, and the superiority of the novel SAE-based DNN is evaluated by comparing with other frequently used approaches.

Index Terms

Fault diagnosis; Power rectifier; Sparse autoencoder; Deep neural network; Feature extraction;

I. Introduction

With the rapid development of power electronics in recent decades, power electronic converters have been widely used in various engineering fields, e.g. high-voltage DC transmission, renewable energy, suppression of power harmonics, high power electrolysis, driving system of inverter-fed motor, electric vehicle and industrial robotics [41], etc. Power rectifier is one of the most important power electronic converters, which is not only used directly for AC to DC conversion, but also acts as the front half of the rectifying and inverting systems. The normal operation of power electronic switches is one of the most important factors related to the reliability and efficiency of the power electronic system. However, because of the exposure to poor working environments, the rectifier is prone to suffer critical failures because of device aging, overloading and unexpected operating conditions, etc. It has been reported that about 38%

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