## Deep Learning-based Fault Detection in Electrical Transmission Lines

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**Abstract.** Fault detection is a critical stage in power systems, requiring swift and accurate identification. This paper introduces an Artificial Neural Network (ANN) tailored for fault identification, utilizing a deep learning approach. The proposed model marks a pioneering effort, employing ANN for fault identification using raw and sampled data from three-phase current and voltage signals collected through simulation from a 14-bus system across various fault and no-fault classes. Performance evaluation metrics such as accuracy, sensitivity, specificity, precision, and F1 score are employed to assess the model's efficacy. Results demonstrate that the ANN model achieves exceptional accuracy and efficiency in fault detection, showcasing its potential as a pivotal tool for enhancing the reliability and performance of electrical power systems. Notably, the suggested model attains a remarkable 99% accuracy across all tested fault scenarios, F1Score 0.99 for fault and non-fault detection with closely matched testing and training loss curves.

Keywords. Power System; Deep learning; Artificial Neural Network; Fault Detection.

## **INTRODUCTION**

The term "POWER system" encompasses electric energy generation, transformation, transmission, distribution, and consumption, much like an organic system. If we likened the power system to the human body, Consumers would be at the extremities of capillaries that provide blood from the aorta to the entire body. It is apparent that the electrical network's stability has an influence on the whole transmission system. However, traditional power system protection and control systems confront new problems as power consumption increases and renewable energy sources grow, lowering the need for grid expansion [1]. Therefore, precise and quick fault detection is essential to minimize the financial losses brought on by power outages, protect grid security, and prevent cascade faults [2]. The methods employed in the Invalid source provided are based on artificial intelligence. the procedure for fault identification and localization in order to speed up fault detection and enhance protection system performance [3]. Artificial intelligence has grown significantly during the previous ten years. Machine learning is a branch of computer science and artificial intelligence., is concerned with imitating human learning using data and algorithms in order to constantly improve accuracy and efficiency. Machine learning is an essential component of the constantly expanding field of data science.

The algorithm provides critical insights for projects related to data mining and is trained to generate classifications or predictions using a statistical technique. These insights facilitate their application and enable enhanced business decision-making [4].

A machine learning technique called "deep learning" uses a large number of examples and essential data, such as photos and movies, to train computers how to perform activities that people perform effortlessly [5]. Several deep learning (DL) models are beneficial tools for supporting a decision-maker with control decisions and planning [6]. Among several intelligent strategies, the artificial neural network (ANN) has been shown to be the most effective artificial intelligence method [7]. Artificial neural networks are used for spaceflight altitude fault detection in addition

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