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Abstract:
With the expansion of the modern power system, it is of increasing significance to analyze the faults in the transmission lines. As the transmission line is the most exposed element of a power system, it is prone to different types of environmental as well as measurement uncertainties. This uncertainties influence the sampled signals and negatively affects the fault detection and classification performance. Therefore, an unsupervised deep learning framework named deep belief network is presented in this paper for fault detection and classification of power transmission lines. The proposed framework learns the beneficial feature information from the uncertainty affected signals with a unique two stage learning strategy. This strategy enables the proposed framework to extract lower level fault-oriented information which may remain unobserved for other alternative approaches. The efficacy of the proposed framework has been examined on the IEEE-39 bus benchmark topology. The in-depth accuracy assessment with different accuracy metrics along with exclusive case studies such as the influence of noise, measurement error as well as line and source parameter variations will be conducted in this paper to justify the real-world applicability of the proposed framework. Furthermore, the relative performance assessment with the cutting-edge rival techniques is also presented in this paper to verify if the proposed framework attains a state-of-the-art classification performance or not.

Keywords:
Deep learning; F1 score Fault analysis; IEEE-39 bus; Line parameter variation; Measurement error; Noise immunity; Robust classification; Transient signature; Unsupervised model