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Transmission Line Faults Analysis Using S-Transform and ELM

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Abstract: *The S-Transform (ST) and Extreme Learning Machine (ELM)-based fault detection and classification approach for overhead transmission lines is presented in this research. The system is simulated in the PSCAD environment, where three-phase current signals are extracted from the sending end of the transmission line. These signals are processed using S-Transform to generate S-matrices, which provide a time-frequency representation of the signal. From the S-matrix, a Stockwell Fault Index (SFI) is computed using basic statistical measures. The energy content of each phase signal, derived from the S-matrix, serves as a distinguishing feature for fault classification. These extracted features are then input into an Extreme Learning Machine (ELM) model for classification of faults. The study investigates various fault types, including single line-to-ground (LG), double line (LL), double line-to-ground (LLG), and three-phase to ground faults (LLLG), under varying fault inception angles (FIAs). A total of 65 fault scenarios are simulated to train and validate the proposed system. The model is implemented in MATLAB, and the results demonstrate the method's efficiency in terms of speed and classification accuracy. The proposed technique is suitable for real-time fault detection and classification in transmission networks.*

Keywords: Stockwell Transform, Stockwell Fault Index, S-matrix, Transmission Line Faults, Extreme Learning Machine (ELM), Fault Classification

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