

ABSTRACT

Transmission line protective relaying is an important aspect of reliable power system operation. Transmission line relaying has evolved into a multifunctional scheme comprising of tasks like detection, classification and location of faults occurring on transmission lines. The advent of digital relays has resulted in significant improvements in transmission line relaying. Digital line relaying techniques employing various mathematical techniques are already available but scope of future work remains.

In the present work, attempts have been made to develop improved methodologies for detection, classification and location of transmission line faults by applying various techniques. A differential equation based approach for fault location, a wavelet analysis based approach for fault detection and classification, an artificial neural network (ANN) based approach for fault classification and an ANN based approach for fault location have been suggested. Each one of the proposed methodologies, has novelty of some form or other.

The proposed differential equation based fault location approach aims at finding the line inductance up to the fault point in the case of non-zero fault point resistance. Corrective measures in the form of data filtering and error compensation have been incorporated with the fault location algorithm to take care of the variable operating conditions.

In the wavelet analysis based fault detection and classification approach, biorthogonal spline wavelet has been used as the mother wavelet. Both detection and classification of faults are performed at level-1 of wavelet multi resolution analysis (MRA). Whereas for fault detection

level-1 details of three phase currents are sufficient, for fault classification level-1 details of the delta currents are also required to be considered.

The proposed ANN based fault classifier is based on radial basis function (RBF) ANN and has been designed to work with current inputs only. Two ANNs, one for classifying faults involving ground and another for classifying faults not involving ground have been used. Unlike the approach adopted by the previous researchers where the ANN inputs are in the form of a single vector, in the proposed scheme the inputs are presented in the form of multiple vectors. Presenting the inputs as multiple vectors enhances the ANN capability.

The proposed ANN based fault locator is also based on RBF ANN. Both current and voltage samples are used as inputs in this case. The proposed fault locator uses two ANNs instead of one ANN for each type of fault. The two ANNs are trained with different values of “spread”. One of the two ANNs is meant for locating faults occurring within about 50% of the line length and the other one is meant for faults occurring beyond this range. It has been observed that by using two ANNs more accurate estimates of fault location can be obtained.

To validate the proposed fault detection, classification and location schemes, studies have been carried on two simulated power system models: one in which the transmission line is fed from one end and another in which the transmission line is fed from both ends. The models are subjected to different types of faults while operating at different operating conditions and performances of the proposed algorithms are evaluated. The results of the simulation studies, which are presented in this dissertation, confirm the feasibility of the proposed algorithms.