PREFACE

The transmission network is an integral segment of the power system as it transfers the bulk power form generating units to the distribution stations. The ongoing fundamental changes in the transmission system with the induction of emerging energy resources and electronic devices comprehensively increase the intricacy of the modern electric grid. In recent few years the network compensation mechanism has been comprehensively utilized as a potential alternative for enhancing the line flow competency. However, on account of network protection, the installation of compensating units in the transmission grid gravely influences the distance relaying strategies and also leads to the evolution of different undesirable phenomena like voltage inversion, current inversion, addition of harmonics and much more. The shunt fault events in the transmission lines frequently hampered the reliability and functioning of the power grid. Moreover, the erratic functioning of the allied safety units associated with the compensating devices during shunt abnormalities also leads to unreliable functioning of protecting units. The absence of rapid and pertinent protection strategy may actuate wide spreading of outages and leading to collapsing of the whole grid. Hence the development of competent protective measures for modern grid structure needs to be properly addressed. The major problem involved in the power network protection is to detect, identify the category and precise location of the fault events in the transmission lines.

The present research work addresses the detection, categorization and distance estimation of the normal shunt fault events and transforming fault events in a series compensated power transmission network using signal processing mechanism and machine learning techniques. Most of the existing fault diagnosis approaches transcribed in the literature have only considered usual shunt fault cases. Similarly, the impact of CTs saturation on the employed protection methodologies is also not very commonly addressed in the available articles. In contrast to that the present thesis along with usual shunt fault cases, these critical issues are also considered during the analysis. In the present work dominant fault feature extraction based intelligent fault ascertaining methodology has been utilized. The extracted features (by DWT and EMD) have been fed to machine learning based classifier and distance estimator models for ascertaining the fault events in the compensated power network. In the present work KNN, SVM, PNN, Ensemble learning, and DNN based classifier models have been applied for categorizing the fault events in the series compensated power network. The ensemble classifier models are more robust than single classifier based methodologies due to its majority voting weighing attribute. The time response of the deep learning based fault events ascertaining mechanism is faster than ensemble, K-NN, and PNN based mechanism. Application of ensemble and DNN classifier models are more efficient if the training dataset is very large. Similarly for locating the fault events in the trasnsmission circuit, neural network based distance estimator models have been utilized. The proposed protection scheme has been validated on different simulated test transmission circuits such as two bus mid-point series compensated transmission network, mid-point compensated parallel-circuit transmission and source end-side compensated interconnected transmission network. The results acquired during the testing for all considered cases on different simulated test networks show the relevance and applicability of the proposed protection scheme. It has been also reaffirmed that the proposed methodology is well competent of providing precise localization and categorization of fault events in the compensated transmission network irrespective of fault circumstances such as types of fault, location of the events, fault inception angles, fault resistances, point of compensation and level of line compensation percentage.