ABSTRACT

The generous production of electrical energy remains as a primary representation for country's GDP growth and overall national strength. Initially, the electric power systems comprise of linear loads and the quality of electric power is measured by means of two major parameters like frequency deviance and voltage deviance. The rapid growth in Indian economy simultaneously increases the electric power demand. In order to guarantee the security, accuracy and economic operation of power grids and electrical equipment, certain control and compensation technologies must be adopted to increase the supply voltage quality. The primary condition for these control and improvement of power quality is to obtain timely disturbing source of accurate information. Thus, monitoring and investigation of PQD is the prerequisite for rapid detection, identification and mitigation of various power quality events present in an electric power system.

The research work entitled "Monitoring and mitigation of power quality events using signal processing techniques and custom power devices" is focused on the detection, identification and alleviation of electric power quality disturbance (PQD) signal using signal processing techniques and Custom Power Devices (CPDs). In this work the signal processing techniques such as S-Transform and Hilbert Huang Transform (HHT) is proposed for monitoring the PQD signals and the design of custom power devices are developed to mitigate the PQD and improve the overall quality of the power demanded by the end users. In this research work, the monitoring of PQD signals using S-Transform is analysed as a simple and effective method for detection of PQD signals. The classification of PQD signals have been implemented using a rule based decision tree for different noise levels, such as with no noise, 30dB noise and 45dB noise. According to a rule based decision tree, seven types of single power disturbance and sixteen types of

complex power disturbance are well identified in this work. The proposed work is simulated using MATLAB simulation and the various results are found which detects the single and complex power quality disturbances. Monitoring of PQD signals using Hilbert - Huang Transform (HHT) is proposed as most promising signal processing technique for detection and identification of PQD signals present in the power grid. HHT is an original non-stationary time series electric power signals processing technique, comprises Empirical Mode Decomposition (EMD) and Hilbert spectral analysis. The recommended task is simulated with MATLAB then several outcomes exist, that detects various PQD signals including pure sine voltage signal as a reference waveform.

Alleviation of PQD signals can be implemented with the help of Flexible Alternating Current Transmission System (FACTS) based family device called as Custom Power Devices (CPDs). The types of CPDs are classified based on the type of connection such as series connected device known as Dynamic Voltage Restorer (DVR), shunt connected device called Static Synchronous Compensator (STATCOM) and the combination of series and shunt connected device referred as Unified Power Quality Conditioner (UPQC). In this research work, the design of proposed CPD is validated by enhancing the performance of CPD by mitigation of PQD. Different types of controllers like PI controller and Fractional order PI controller are carried out with the help of MATLAB simulations to mitigate the PQD. Based on the results, a 2kVA hardware prototype of UPQC is designed using fractional order PI controller to compensate the variations in the supply voltage and flow of harmonic current from load to source connected with 1HP three phase Induction motor and it is found that UPQC is a unique device to improve overall power quality of the power system by mitigating both voltage variation events and harmonics present in the power system.