Chapter 11
A Comparative Study of Power Quality Monitoring Using Various Techniques

Fatma Zohra Dekhandji
University M'hamed Bougara of Boumerdes, Algeria

Mohamed Cherif Rais
University M'hamed Bougara of Boumerdes, Algeria

ABSTRACT

In recent years, power quality (PQ) has become an increasingly major concern for both electric utilities and the end users. Accordingly, the electrical engineering community has to deal with the analysis, diagnosis, and solution of PQ issues using system approach rather than handling these issues as individual problems. This chapter describes the analysis of PQ using advanced signal processing tools represented in Hilbert and wavelet transforms (HT-WT) and artificial intelligence tools represented in artificial neural network and support vector machine (ANN-SVM) for detection and classification of power quality disturbances, respectively. These techniques were successfully simulated using LABVIEW software capabilities. The results of simulation indicate that the signal processing techniques are effective mechanisms to detect and classify power quality disturbances. At the end, the combination of WT as a tool of detection and features extraction with SVM as a classifier tool resulted as the best combination for PQ monitoring system.

LIST OF ABBREVIATIONS

PQ: Power Quality.
PQD: Power Quality Disturbances
PQM: Power Quality Monitoring
IEEE: Institute of Electrical & Electronic Engineers
ANSI: American National Standards Institute

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WT: Wavelet Transform
CWT: Continuous Wavelet Transform
DWT: Discrete Wavelet Transform
DWC: Discrete Wavelet Coefficients
MRA: Multi Resolution Analysis
HT: Hilbert Transform.
NN: Neural Network
ANN: Artificial Neural Network
FFNN: Feed-Forward Neural Network
RNN: Recurrent Neural Network
SV: Support Vector
SVM: Support Vector Machine
ST: Stock well Transform
CZT: Chirp Z-Transform
FT: Fourier Transform
DT: Decision Tree
FL: Fuzzy Logic
HP & LP: High Pass & Low Pass Filters
RMS: Root Mean Square
THD: Total Harmonic Distortion

INTRODUCTION

Power quality is known as one of the very serious issues in electric power transmission and distribution, manufacturers and end users because of its bad effects on electricity suppliers.

Power quality is a term of many meanings; each meaning relies on the reference to which it is attributed. For example, a utility may define power quality as reliability of its system. A manufacturer of load equipment may define power quality as those features of the power supply that enable the equipment to work properly. The end user's point of view of power quality is that any power problem manifested in voltage, current, or frequency deviations that result in failure or malfunction of customer equipment (McGranaghan et. al., 1996; Dekhandji et al., 2017; Dekhandji, 2018; Recioui, 2018).

Power quality is generally meant to express the quality of voltage and/or the quality of current which can be defined as: the measure, analysis, and improvement of the bus voltage to maintain a sinusoidal waveform at rated voltage and frequency; this definition includes all momentary and steady-state phenomena (Masoum and Fuchs, 2011).

All electrical devices are likely to fail or not work properly when exposed to one or more power quality problems; these devices react negatively to power quality issues, depending on the severity of problems. A simpler and may be more concise definition might state: "Power quality is a set of electrical boundaries that allows a piece of equipment to function in its intended manner without significant loss of performance or life expectancy." This definition contains things needed from electrical devices which are performance and life expectancy (Sankaran, 2001,).

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