



Detection and classification of power quality events by expert system using analytic hierarchy method

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Received 17 July 2018; received in revised form 10 August 2018; accepted 16 August 2018

Available online 1 September 2018

Abstract

The classification of various power quality events during the integration of renewable energy sources were proposed in this article. This approach provides a data mining tool linear discrimination analysis for the feature extraction in the expert system where an analytical hierarchy process is used in the knowledge base with the various levels of power quality events. Based on the hierarchy levels the data were compared using the group data handling method and thus the power quality events were classified. To validate the results a real time sample data were used.

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Keywords: Electric power quality; Expert system; Linear discrimination analysis; Analytic hierarchy process; Group data handling method

1. Introduction

The demand of power creates a challenge in the utility. To meet the scarcity of power renewable power was introduced. The generation of power by renewable energy sources introduces another challenge for the power engineers: like frequency deviation, power quality and power system instability. Power quality dominates more in terms of utility and consumers. Integration of renewable energy system is a tough task in it involves a large number of economic and technical issues. To deal with such tough challenges, one may have to segregate the issues and need to take appropriate actions to solve such issues. The collected data need to be interrupted therefore the expert system must be versatile, accurate with good reliability. Since the collected data are not self descriptive, they need human intervention to identify and classify power quality event.

Expert system approach will help the consumers to identify and classify the various power quality events that may occur during the integration of renewable energy sources.

The use of equipment sensitive to power system disturbances and the integration of renewable energy sources create an increasing awareness of power quality events. To identify and classify monitoring systems is required to solve the problems that may occur during the integration of renewable energy sources in a smarter and effective way. Wavelet transform is used to detect the PQ events (Huang, Yang, & Huang, 2002).

Numerical based studies like Fourier transform-based method were found unsatisfactory. The outcome of those transformation methods becomes complex to comprehend (Brigham, 1990; Girgis and Ham, 1980; IEEE Task Force, 1993). Several power quality problems are analyzed using both the S-transform and discrete wavelet transform, showing clearly the advantage of the S-transform in detecting, localizing, and classifying the power quality problems (Dash, Panigrahi, & Panda, 2003). Novel method of higher

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efficiency in signal-processing applications becomes important in addition to traditional methods.

Study on expert system, proposing the decision or identification of PQ events in a power industry was done using several methods like combined analytic hierarchy process, fuzzy expert system, multi criteria decision making techniques, weighed average method and priority setting method (Piltan and Erfan Mehmanchi, 2012). The application of group data handling method was used in determining the process parameters and tensile strength for the fused deposition modeling (Rayegani and Onwubolu, 2014). Heuristic free method used to predict the environmental pollution (Tamura and Kondo, 1980). Fisher Linear Discriminate Analysis method is used to enhance the effect of variation caused by different individuals, other than by illumination, expression, orientation which is applied for image feature extraction (Rayegani and Onwubolu, 2014). The error criterion is better in shortened non-physical forecasting models. (Aksenova and Yurachkovsky, 1988; Ivakhnenko and Yurachkovsky, 1986). A multi-layer architecture ANFIS is good predictors which is used in identification datasets of thoracic surgery, fertility diagnosis, breast, energy, and glass (Iraji, 2018). A knowledge-based neural network management algorithm is proposed for wind energy systems (Abbey, Strunz, & Joós, 2009).

An expert system proposed for the classification and determining various power quality events comprises a three important modules. The preprocessing module is made using linear discrimination method and the processing method is made using the group data handling method

2. Power quality issues

Power quality issues can be viewed in two perspectives one is on the utility side and the other is customer perspective. In the view of utility perspective it relates with system reliability and in the view of customer it is an event that is manifested with current, voltage and frequency.

The power quality issues like Sag, Swell, Interruption, Transients, Harmonics and Flickers were as shown in Figs. 1a–1f.

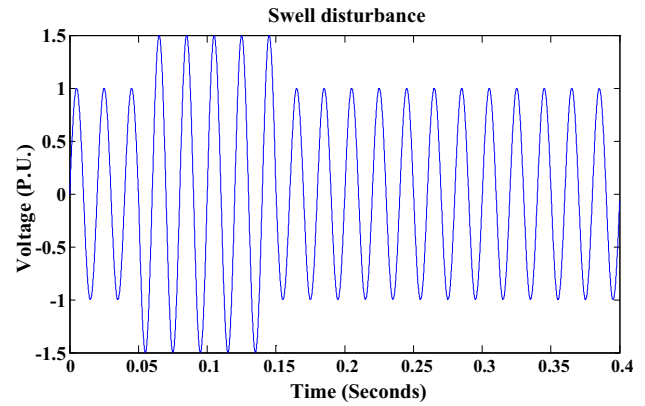


Fig. 1b. Swell event.

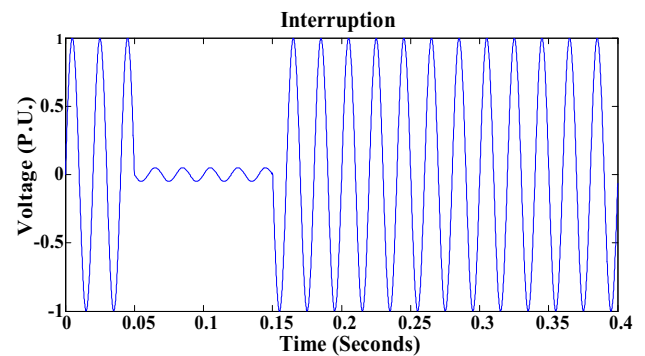


Fig. 1c. Interruption event.

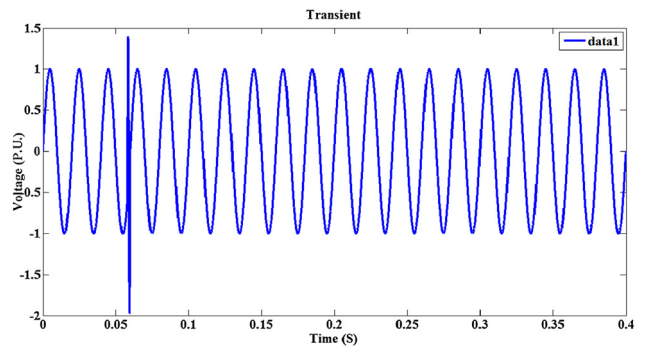


Fig. 1d. Transient event.

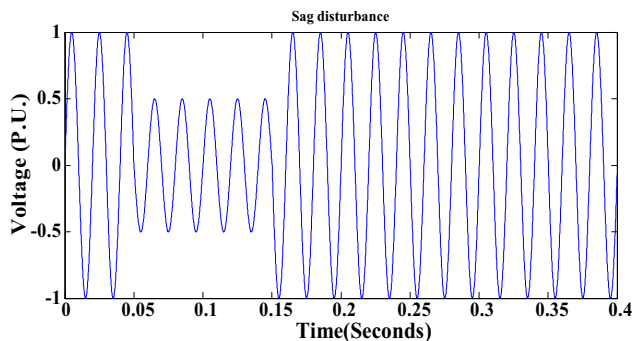


Fig. 1a. Sag event.

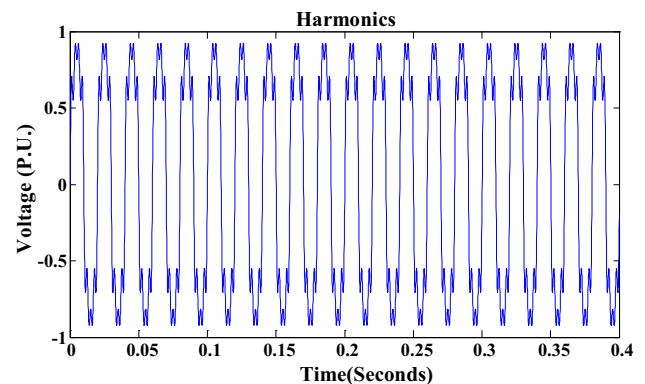


Fig. 1e. Harmonics event.

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