UNIVERSITI TEKNOLOGI MARA

IDENTIFICATION AND CLASSIFICATION OF VOLTAGE DISTURBANCES IN POWER QUALITY STUDIES USING WAVELET-FUZZY METHOD

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CHAPTER 1

INTRODUCTION

1.1 Introduction

Power Quality (PQ) problems have been classified as one important field for consumer, manufacturer and utility [1-3]. The impacts of low PQ have given massive losses in term of monetary, low quality product and increase in maintenance [4]. Low PQ is originated from various factors such as harmonic polluted system, improper grounding and magnification of voltage due to the capacitor switching [5]. These factors normally can be mitigated if the knowledge of PQ is improved. However, the PQ problem is impossible to be avoided. As far as PQ is concerned, the indices of quality of power can be upgraded if the cause of problem could be identified [6].

Experts have classified the PQ problem or power disturbances into different classes based on voltage and current signals pattern [7-9]. These signals originate from different causes and create different problems to the electrical system. Thus, the identification of these signals is important before a proper finding and mitigation action can be taken [10-13].

1.2 Review

The following presents some highlights from published work on identification and classification on power disturbance and its mechanism. This review is divided into two main categories, the classical and the modern technique.

1.2.1 Classical Identification and Classification Approach of Power Disturbance

There are many types of disturbances reported in the literature [14-15]. Basically, the pattern of the disturbance has been sorted based on the deviated pattern that occurs in the power signal particularly voltage characteristic [16-17]. The reason of sorting those various disturbances due to the factors as listed below [18]:

i. Each type of disturbances originated from particular causes.
ii. The decision on mitigated technique is based on the type of disturbances.

Computer Business Equipment Manufacturers Association (CBEMA) curve is the common approach to identify and classify power disturbance. The CBEMA curve represents the voltage magnitude versus time of the occurrence of the disturbance as shown in Figure 1.1 [19].

The dotted signals in Figure 1.1 show the disturbances that encountered during monitoring period. The dotted signals enveloped by the curve show that the load is still able to withstand those disturbances. Since the dotted signals in Figure 1.1 are located in the curve coverage, hence, the disturbances that occurred in the system are controllable. The dotted signals that are located beyond the curve give an indication that the disturbance can cause severe drawback impact to the load [20].

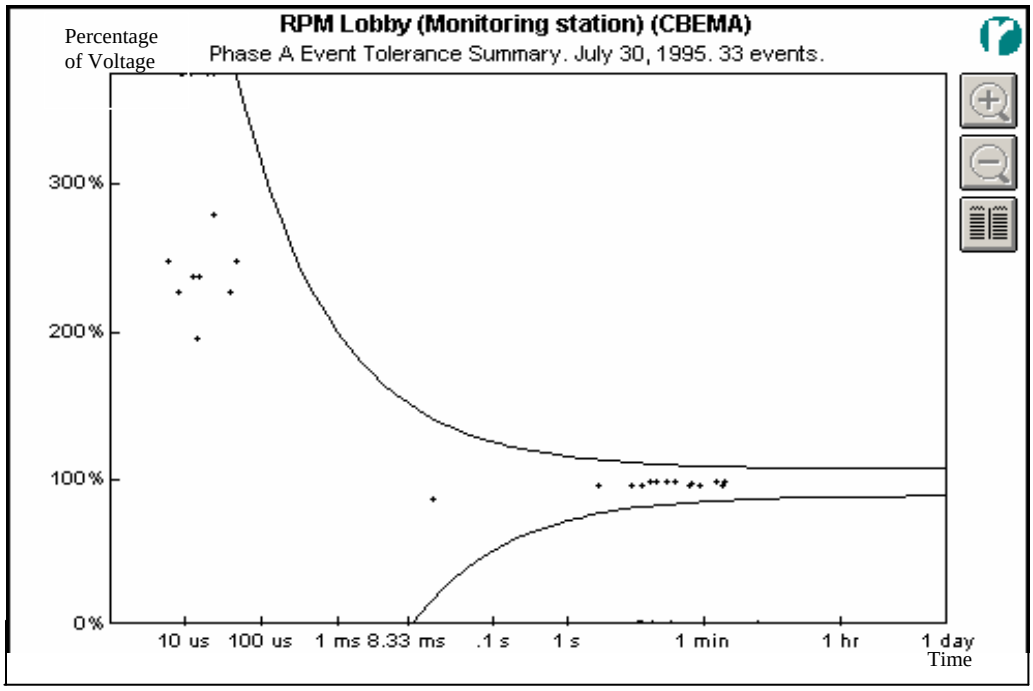

Figure 1.1. The dotted signals show the disturbance occurred in the monitoring system

One could interpret the type of disturbance by focusing on the x-axis of the curve. The instantaneous disturbances (oscillatory and impulsive transient) normally occur on the left-hand side of the curve, which is between 0 to1 ms. The root mean square (rms) disturbance is encountered between 1 ms to an hour, while the right side of the curve indicates the steady state disturbances in the system. The waveform of the disturbance can be observed by clicking on a dotted disturbance. Figure 1.2 shows a waveform disturbance occurred from one of the dotted on the CBEMA curve.

The rapid growths of computer application and signal processing have contributed a massive number of approaches on classifying the various type of power disturbance [21]. The combination of signal processing and artificial intelligence is one of the popular techniques.

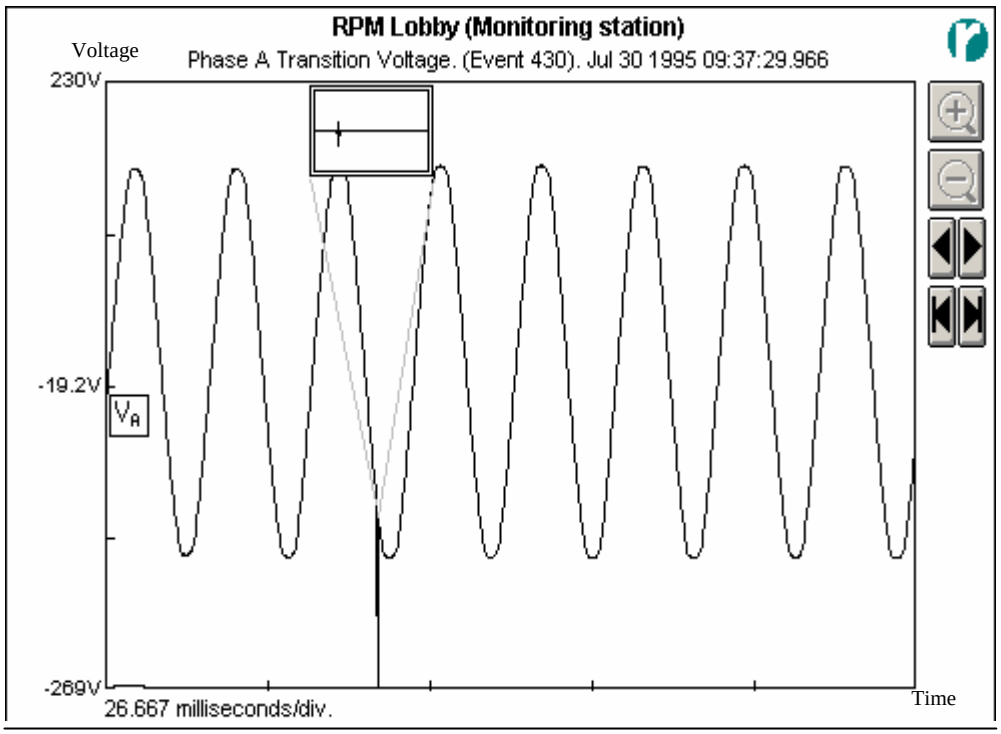

Figure 1.2. The disturbance from one of the dotted from CBEMA curve.

1.2.2 Modern Approach

In this decade, with the rapid advancement in computer technology, high power signal processing has been made possible. Recently, the application of AI is a popular tool for power disturbance classification. The rigorous and time consuming as well as high accuracy technique is explored throughout the AI implementation on this particular field. The purpose technique is developed based on AI base application tools. This new technique is implemented through 2 stages; Discrete Wavelet Technique (DWT) as a signal processing tools and Fuzzy Logic (FL) as classification tools. The DWT, as a signal processing technique is an appropriate technique to extract the power disturbances signal. FL produces a robust technique to recognize the type of disturbances via DWT features. Analysis and the development of software application were carried out to produce and analyze the result on the application of the unified system (DWT and FL)