고조파 추출을 이용한 불량애자 검출장치 개발연구

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Defective Porcelain Insulator Inspection Based on Harmonic Retrieval

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Abstract

Porcelain insulators are widely used in overhead high-voltage power transmission lines while providing adequate insulation to withstand switching and lightning over voltages. For the safety consideration, we proposed a novel insulator inspection method using harmonic, which is retrieved from the low frequency signal. The working principle of this new method is based on the relationship between the low frequency harmonic and the defective characteristic of the insulators. So, in this paper, the harmonic retrieval in the complex noise is solved with the HOC (High Order Cumulants) is extended. In the experiment, as one of our dedicated contribution, we illustrate low frequency harmonic and the defective characteristics of the porcelain insulators.

I. Introduction

In order to improve porcelain insulator field test methods, many experts around the world have also engaged in the development of the new types of porcelain insulators testers. For example, the use of electric field to access the condition of insulator and detect internal defects, which has been proved in [1]. Bologna introduced the inspection method composed by infra-red image technique in his paper, Kazuo Yamamoto using the fusion technology of infrared (IR) and color images is also tried to generate a virtually enhanced image [2]. However, the inspection method based on the electric field is not very accurate and the price of the infrared image device usually very high.

In this paper, as a kind of harmonic detection device, it is proposed a defective insulator detector, which can be used at a certain distance from the defective insulator by means of analyzing the radiating noise and establishing the harmonic retrieval method. In this way, it can prevent the unexpected power trouble and efficient maintenance of the power transmission lines.

II. Harmonic retrieval

In our paper, a novel electronic wave inspection method was developed based on analysis of the low frequency even order harmonic of the basic power line transmission frequency (60 Hz), in order to obtain the harmonics from the complex noise

environment, the algorithm using the slice of the sixth-order time-averaged moment polyspectra is employed as follow:

$$\overline{M_{6,x}}(\lambda_1,\lambda_2)|_{\lambda_1=0} = 2A\sum_{l=1}^{L} E^2\{S_l^*(t)S_0(t)\}\delta(\lambda_2-\omega_l) + A^2E\{S_0^*(t)S_0^*(t)\}(t)\delta(\lambda_2) \quad (1)$$

This experimental method can be used on the high voltage power transmission line, and disregards the color and distribution of the noise.

Ⅲ. Experiment

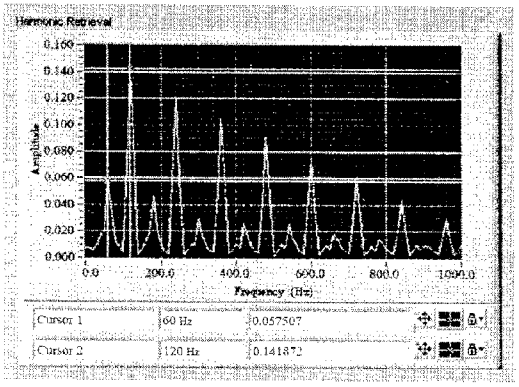

Figure 1. Harmonic spectrum of the normal insulator

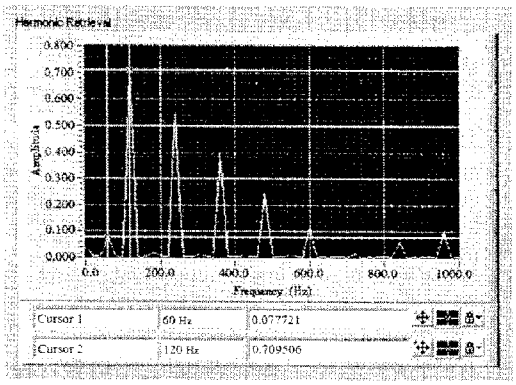

Figure 2. Harmonic spectrum of the defective insulator

In the experiment, the insulators are divided into two groups, one was composed by the normal insulators, and another was defective. The antenna of the receiver board was fixed 1.5 meters from the insulator. The insulator was connected to the 23KV AC. Figure 1 shows the harmonic retrieval frequency spectrums of the normal insulator, while the Figure 2 illustrates the harmonic retrieval frequency spectrums of the defective insulator.

Compared these 2 groups of the graphs, it is clear that the even harmonics of the defective insulator are remarkably increased, while the odd harmonics don't have any obvious variance, especially in the low order harmonics band, this characteristic is evident. So, in this paper, 120 Hz (one order even harmonic of the basic power line transmission frequency) is chose as the criterion to evaluate the quality of the high voltage insulators. Insulator display in the figure 1 and the figure 2 are the ordinary samples from our experiment. Except that, other insulators have the same characteristic, that is, at the frequency point 120 Hz, the amplitude of the defective insulator is more than 4 times of the amplitude of the normal one.

Ⅳ. Conclusion and future research

a novel electronic wave inspection approach wes developed based on analysis of the low frequency even order harmonic of the basic power line transmission frequency, According to the real experiment, it is confirmed that the proposed algorithm can be used in the high voltage power line area and disregard the color and distribution of the noise. The analysis of the characteristic of even harmonic and the odd harmonic is left for the future research.

Acknowledgement

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Reference

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