The Aging Diagnosis of HFPD Using the Delta-F Reformation for the Mobile Monitoring Systems.

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Abstract: The partial discharge testing is widely used in insulation property measurement because it fives low stress to high voltage equipment which is undertaken tests. Therefore it is very useful method compare to previous destructive method in power transformer that requires on-line & on-site diagnosis. Partial discharge pattern so it is required continuous research to development of precise analysis method. In recent, the study of partial discharge is carrying out discover of initial defect of power equipment through condition diagnosis using HFPD(high frequency partial discharge) detection. In this study, simulated transformer is manufactured and PD/HFPD occurred from transform is measured wit broad band antenna in real-time the degradation grade of transformer is analyzed through produced reformation patterns is simulated transformer according to applied voltages.

Keywords – Partial Discharge pattern, Condition Diagnosis, Reformation patterns, HFPD

1 INTRODUCTION

Despite of the growing number of applications and development of PD test systems, the question how the measured partial discharge quantities relate to the residual lifetime of a specific test object still remains open. The complexity and fuzziness of measured discharge signal patterns in the real noisy world, such as acoustically, chemically, electrically, thermally or any other methods, can be interpreted as a type of imprecision that stems from grouping elements into classes that do not have sharply defined boundaries. For the diagnostic recognition results of our vague was measured an information group of their pattern features from high voltage system. The characteristics of aging processing, prediction and statistical discharge pattern recognition of uncertain information in power system allows a neural network to deal with situation or may have some corrupted data.

In this respects, this paper presents a new aging recognizing system concerning analysis of measured HFPD pattern performed on different high voltage apparatus and models of power systems. The advantages provided by those PD pattern recognizing analyzer are the possibilities to perform more reliable identification of aging process and to predict the lifetime of the tested insulating system.

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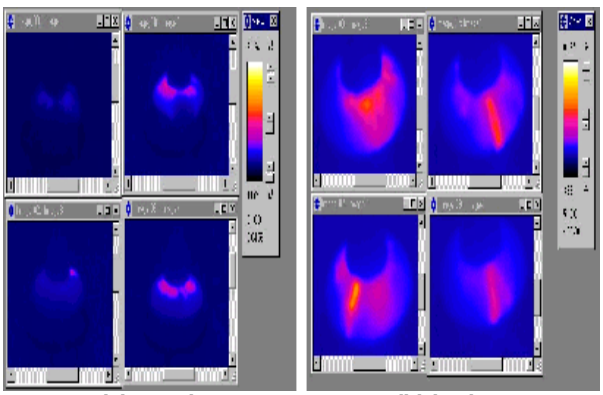
2 HFPD MODEL ACCUMULATION

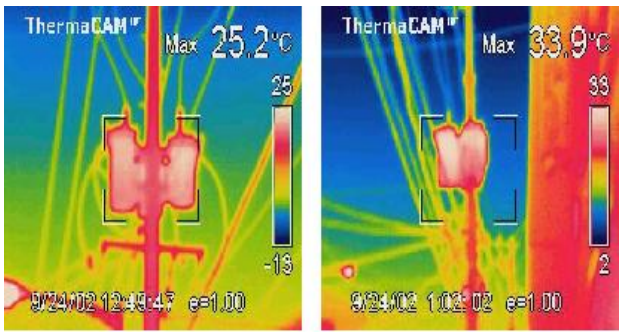
The aim of HFPD pattern recognition is to assign a label to a PD pattern of unknown origin from previously collected patterns with knowledge data group. The PD recognition is also possible by clear separated groups compare to the other frequency progressing types of information group, the combination of many integrated physical signal quantities, the statistical models and the acceleration parameters which was characterized the PD pulse/shape measured by discharge displacement in electromagnetic waves, acoustic waves, light and infrared/ultraviolet rays etc

The aging diagnosis of neural approach of PD has been very successful applied to the various practical problems as a complex field application. The important reason is its ability to learn the required input-out information mapping from accumulating examples as a based model. Photo 1 shows the example of state estimation according to an IR monitoring test to be connected with insulator. For the last couple of years, almost research works on SD has been concluded by the experienced visual/audible inspection represent the operational condition. But practical HFPD testing represented a frequently used case in high-stress state to be probable so 3 times(3Uo) compared to the field strength.



(a) good case **(b) bad case**

Photo. 1. The case of IR monitoring in Porcelain



(a) case 1 **(b) case 2**

Photo. 2. Temperature Difference according to operational condition.

Photo 1 has been represented the physical modeling of Porcelain, and photo 2 means IR monitoring results of operational transformer in a field testing of MV class network.

Furthermore, the external noise caused by multi-connected earth type has been modified to the extremely complex patterns. We have a careful in frequency attentions about the HFPD signal measurement techniques because the reliable selection of input mapping determines the discrimination speed, data accumulation and statistics parameter for a reliable diagnosis system with PD information.

Finally, our research will be proposed the normalized process of frequency variation terms for the relative reformation.

3 EXPERIMENTAL SETUP

Fig. 1 represents the mobile schematic diagram of suggested systems with a GPS. In out experiment, the construction of simulating aging setup based IEC-270 model is widely used in insulation property measurement.

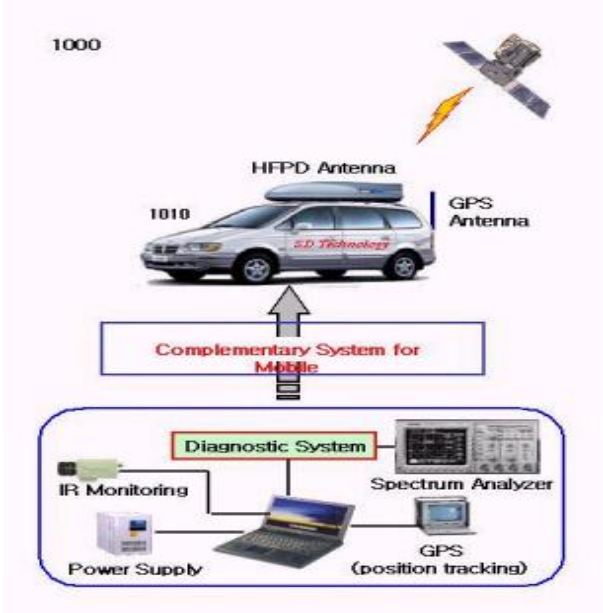


Fig. 1. Schematic diagram of diagnosis system for mobile on-line system

One of the most significant advances has been made to the on-line measurement technology in part of HFPD pattern recognition,

For example, in the papers of the reference it was demonstrated that neural networks using the statistical measuring techniques can readily distinguish between the partial discharge in stress and operational condition characteristics.

The first important step is to select a frequency ranger using spectrum analyzer, because the frequency characteristics of PD represented the complicated patterns depend on applied the field strength, the defect types, the discharge types and the PD complexity. Especially, the HFPD distribution and its derivatives such as frequency distribution from several tens [KHz] to several[GHz] frequency have been extensively used for recognition.

The secondly, we has been prepared the sampling part concerned about information mapping of measuring type of HFPD pattern. Due to lack of "a prior knowledge or information" of concerned problems there is no unique way to do this.

Our results the HFPD application if reasonable measurement is powerful tool for preventive diagnosis of insulation system and has a possibility to adapt in different stress as acceleration test. However, above those system still remains the many problems for actual application. For example, data sampling of PD window, data accumulation for actual system and a random process technique between the LAB testing and the actual field test. Furthermore, the statistical parameters of PD measureing(reputation cycle, sampling time and reformation) have been changing to the accelerated field strength.

4 RESULTS AND DISCUSSION

The most significant advances made with the area of PD pattern recognition primarily concern the effective discrimination ability for the field testing between the conventional technology and proposal adaptive technology.

Especially, HFPD distribution and its derivatives such as (frequency, dB sampling sorting ,etc) distribution have been extensively used for recognition. Due to the lack of information of the concerned problems there is no unique way to do this. Statistical parameters are just few examples of such features. The trade-off between the number of features, time for the calculation of the features discrimination power of the features and the final speed of classification should be considered when designing the features.

Mapping techniques and cluster analysis methods can be used for this purpose but it should be realized that there is no 'best' method.

a)Case Study 1: Reformation Aspects

The measurement of HFPD was carried out the computer programming using recurrence sampling technology during the measured frequency. The PD data group must be exchanged to the dB axis according to the frequency axis during the recurrence sampling of applied electrical stress.

Fig. 2 show the frequency variation according to applied stress. Those results represent a clear description of the frequency domain above the PD initiation, but almost of power system has been operated satisfactory progress under the PD initiation as figure 2(b).

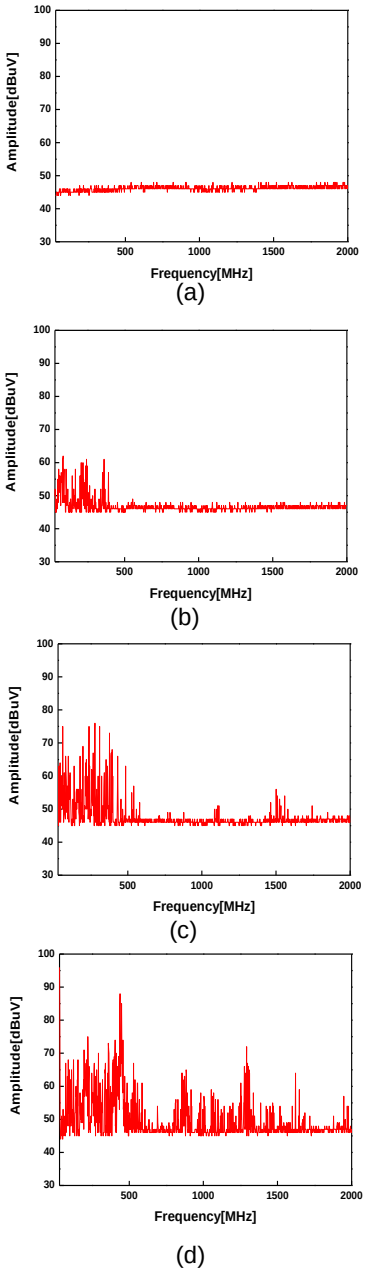


Fig. 2 The change characteristics of HFPD pattern according to applied voltages (specimen : A10, non-thermal aging). (a) 0Uo, (b) 1.5Uo, (c) 3Uo, (d) 5Uo.

The calculation/measurement was done by Borland compiler. Figure 2 shows the statistical distribution result of PD signal during reputation testing

After PD measurement from on-line testing, the random properties of aging processing easily find the complicated variances the corrected result of normalization was decided on reappearance of logarithm value of unit output DB as a recurrent measuring such as Fig. 4 suggested the Delta F Reformation represented gradient values. Figure 5 is a example of normalized PD pattern that remove noise by statistical processing

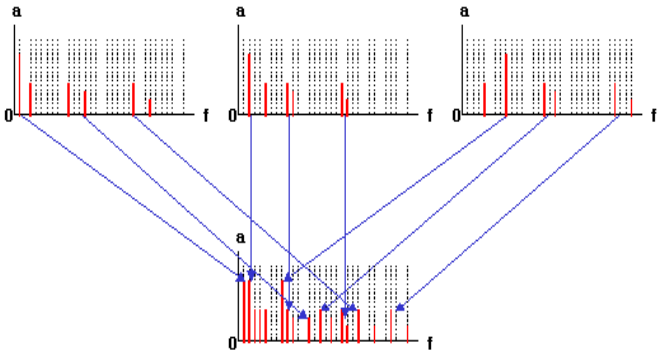


Fig. 3. Example of FRPDA(frequency resolved partial discharge analysis)

$$g_i = \frac{\Delta a(f)}{\Delta f}_i = \frac{a(f_i)-a(f_{i-1})}{f_i - f_{i-1}}$$

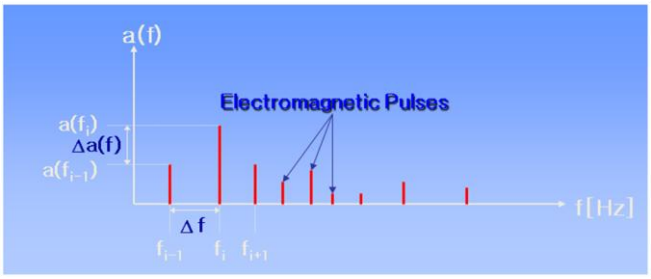


Fig. 4. Example of DELTA F about the gradient formula

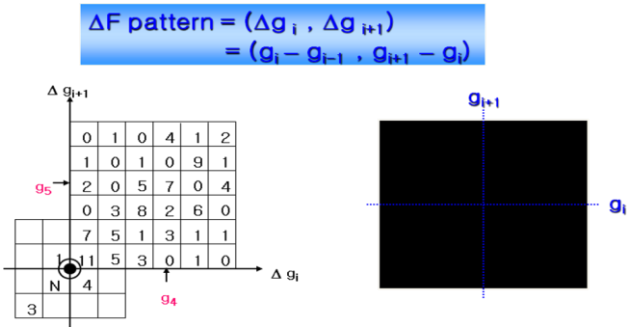
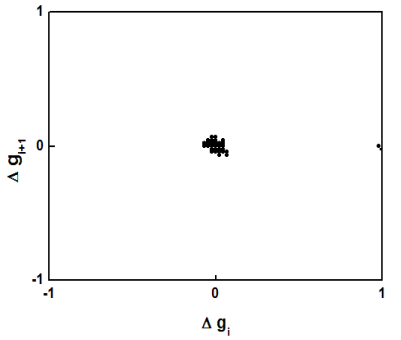
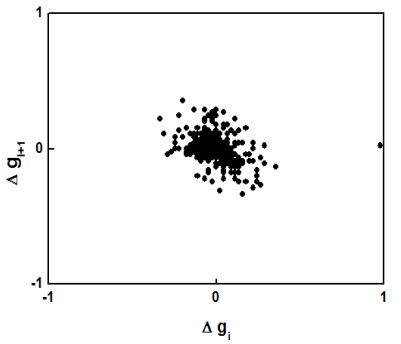


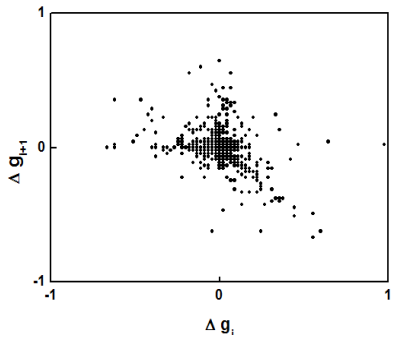
Fig. 5. Example of normalized Delta F pattern acquired by reputational PD monitoring



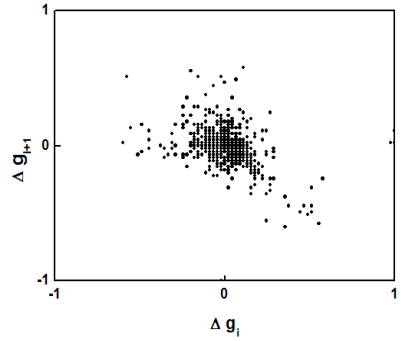
(a)



(b)

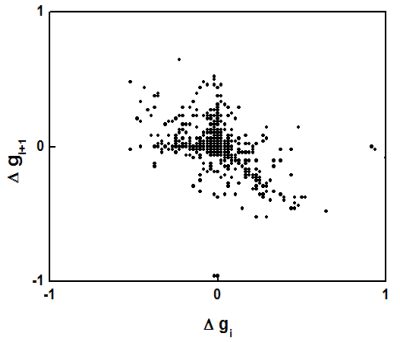


(c)

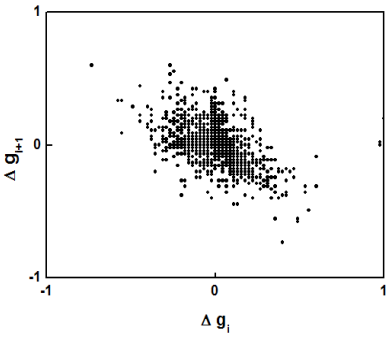


(d)

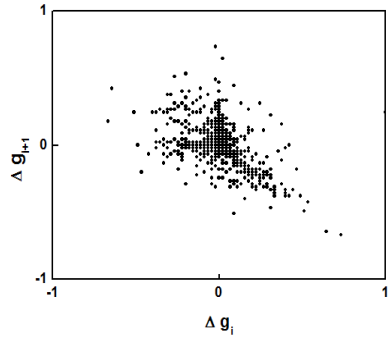
Fig. 6 The change of ΔF pattern according to applied voltages. (a) 0Uo, (b) 1.5Uo, (c) 3Uo, (d) 5Uo,



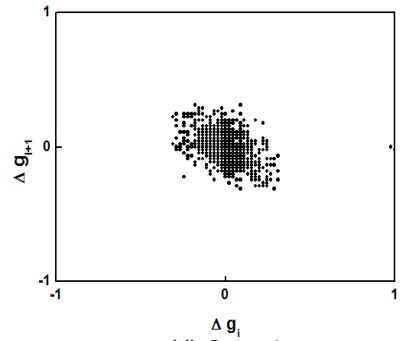
(a) Case 1



(b) Case 2



(c) Case 3

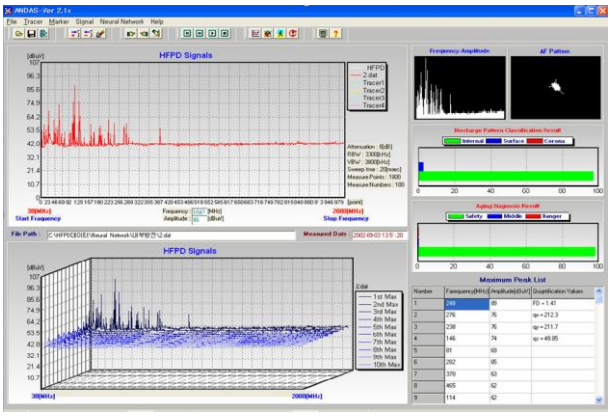


(d) Case 4

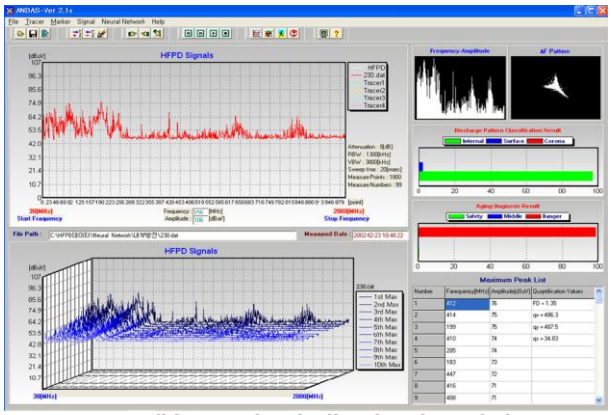
Fig. 7 The change of ΔF pattern according to aging Level.

b)Case Study 2: On-line monitoring Aspects

The measured PD value of the first Max group has an excellent sensitivity compared to the other measurement techniques. However, some measured data was shown a stochastic characteristic. Specially, the field testing in actual system was easily measured to the unknown data with external noise. Figure 8 represented the results of caution indication of 2 kinds that is diagnosed in proposed system.



(a) Caution indication.(Level 1)



(b) Caution indication.(Level 2)

Fig. 8. On-line diagnosis examples.

Almost of aging experiment depends upon acceleration test for analysis of aging processing. In this case, the ration of aging recognition could not be calculated like above section, because results have many unknown points as the complex damping characteristics.

Especially, the testing result involved stochastic aspects was calculated to much interested phenomena after safety area. At the first the ambiguous results growing both two output calculation carry out some special region those output is clear different error of area above section. Unstable area above the section called damping were the discontinuous monitoring areas, those result was estimated on the HFPD characteristics as possibilities of identification of medium state.

At the second, the dangerous area was easily found to the recurrent phenomena of HFPD output.

However, such area is very difficult to analysis of mechanism and to predict the lifetime in present stare, it is possible to discriminate by means of learning data accumulation.

5 CONCLUSION

In this paper a general outline of the development of neural technique based PD diagnostics using normalization and statistics is given with emphasis on problems if the validity if underlying models and the interpretation of results. Some major ANN based approaches are reviewed in this paper, with a discussion of certain problems that also are significant for modern approaches.

The new method called normalization using statistical processing has been introduced and it was shown both a good recognition characteristic and the capability of higher speed calculation comparing with the case of the conventional diagnostic system. Future automated recognition systems should also be able to recognize multiple PD signals and to pinpoint the most dangerous one. Possibilities inspired bye the random engineering for monitoring the aging of insulation by means of PD recognition should also be further investigated. Currently on-going projects related research and development works on this special subject is continuing accompanied with R&D works of ANN technologies and random processing engineering methodologies.

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