Measurement and Denoising of Partial Discharge Signal in High Voltage Cables using Wavelet Transform

S. Madhupriya, R. V. Maheswari, B. Vigneshwaran

Abstract: A huge amount of exploration propagated over the past decade investigates the characterization of Partial Discharge (PD) inception in cable ideology. Underground cables are passed down as surrogate for over hauling in congested areas. The intention of this research is to examine the feasibility of exploring insulation defects present in High Voltage (HV) Cable setup by employing PD disclosure under alternating current (AC) Voltage. Study of PD characteristics has a congregate. In sting connection having merging act characteristics of PD distinctive transformer is worn to compute the accustom of high voltage farm. The connotation of PD on the vigor of insulation has been diagnosed. In PD estimation, eruption can appearing virtue of various species of origin and can span with the structure in contrastive techniques and with contrastive visage. In view of the peradventure to miniature domain of PD beacon it is veridicality to demise them. Therefore, it's necessary to denoise by many techniques. Because of the prevalence of various interferences within the Partial discharge signal, it's necessary to extract those original signals from creaky signal. Within the previous couple of years, many techniques were spring with denoise the PD signals cogently. However it can be complete either the time domain or within the frequency domain. Once the signal method is completed at intervals the frequency domain, the time domain information is lost. Newer the Wavelet Transform (WT) is sanctioned as a powerful tool for PD process as a result of it preserves each time and frequency domains data.

Keywords: Partial discharge, Wavelet transform, Signal to Reconstruction Error Ratio (SRER) and Reduction in Noise Level (RNL)

I. INTRODUCTION

Partial discharge (PD) assessment is an crucial symptomatic contrivance for insulation systems as retrieve culminate can be worn to compute the accustom of high voltage farm. PD unremarkably materialized at defeatists like voids, dent, breach, juncture and delamination [1]. These will manifest in solids, liquids and aerosolized dielectrics. The injury because of the discharge may be calculable looking on the kind of discharges; for instance, internal or surface discharge, termination discharge, corona, electrical treeing, etc., [3]. Cables are extensively pre-owned in potential dispersion and transmittal channel in debt its excellent electrical, mechanical and thermal features. Deficiency might be imported in the operation of carry or established, although cable accomplishing is upgraded. In an empirical working situation, electric field laceration throughout these defects is reshape, exceeding unfavorable possessions upon the XLPE insulation disintegration [2]. Therefore, as PD audit has incline a cardinal device in estimate the attainment of insulation materials, the designing of PD is valuable in supposing a excelling recognition of PD development [5].

So the artificial defects such as cylindrical void is created in cables will provide a better perception of PD characteristics and also prevent a cables from failure [4]. The connotation of PD on the vigor of insulation has been diagnosed. In PD estimation, eruption can appearing virtue of various species of origin and can span with the structure in contrastive techniques and with contrastive visage. In view of the peradventure to miniature domain of PD beacon it is veridicality to demise them. Therefore, it's necessary to denoise by many techniques. Because of the prevalence of various interferences within the Partial discharge signal, it's necessary to extract those original signals from creaky signal. Within the previous couple of years, many techniques were spring with denoise the PD signals cogently. However it can be complete either the time domain or within the frequency domain. Once the signal method is completed at intervals the frequency domain, the time domain information is lost. Newer the Wavelet Transform (WT) is sanctioned as a powerful tool for PD process as a result of it preserves each time and frequency domains data.

II. SAMPLE, EXPERIMENTAL SETUP AND PROCEDURE

A. Cylindrical Void

Cylindrical Void with 2mm and 5mm depth and constant diameter 4mm is created in low tension cable by using drilling machine. The depth of the void is measured by using vernier caliper.

B. Experimental Setup

Partial Discharge measure by using coupling capacitor, testing transformer. The power supply is given as per Fig 1. Fig 1 shows the PD testing connection having merging capacitance, high voltage test transformer, and to detain a XLPE cable. The transformer ranked voltage is 2x0.22/100/0.22kV, ranked current 2x22.8/0.1A, ranked output is 10kVA. Measuring transformer is worn to composed Alternating Current, Direct Current, and impulse voltage. Electric source is given to cable bits by means of transformer. Fig 2 shows a control desk is worn to curb and perform high voltage AC test furnishings. Test arrangement is composed by means of control desk. The PD audit can be eminent from the curb desk, PD meter and computer.
C. Samples
The investigated cable mainly consisted of a stranded aluminium conductor, an insulation of XLPE, an inner sheath layer and armouring and cable outer sheath. XLPE cable samples have length 1 feet. Before test the cable sheath and insulation were carefully peeled. Fig. 3, 4 and 5 shows a test samples of cables.

Low Tension Cable: 1.1 kV
Cross sectional Area: 35 square mm
Insulation thickness: 0.9 mm (XLPE) [R-Y-B-N]
Number of conductor: 6 (Aluminium)
Minimum outer sheath Thickness: 1.4 mm (PVC)
Minimum inner sheath Thickness: 0.3 mm (PVC)
Armouring: Galvanized steel, flat strip

D. Procedure
The transformer output terminal is connected to the Cable. Before that 2mm and 5mm void is created on the cable. Voltage is applied on the cable. PD waveform is captured by partial discharge meter. Fig. 6 shows a Schematic diagram of the test object.

Fig. 6. Schematic diagram of the test object

III. PARTIAL DISCHARGE
In engineering, partial discharge (PD) could be a localized dielectric failure (which doesn't fully form the bridge the distance between the 2 conductors) of limited low portion of a solid or fluid electrical insulation scheme under high voltage (HV) emphasis[6]. In paper-insulated high-voltage power phases, partial discharges establish as trifle pricks ingoing the paper windings that are beside to the electrical conductor or outer sheath [7].
As Partial discharge bustle improvement, the monotonous lapdordan eventually create durable chemical variance at parenthesis the troubled paper tiers and infuse dielectric fluent [8]. Additional time, partly escort carbonized branches are forged. This places preeminent emphasis on the tarrying insulation, emerging in additional progress of the broken region, renitent steamning on the tree, and additional scorching invoked to as trailing [9][10]. This ultimately terminate within the complete material failure of the cable and, typically, an electrical fulmination. Partial discharges lavish energy within the variety of heat, sound, and light. Localized heating from PD cause thermic deterioratioin of the insulation. The purity of insulation in high voltage instruments will be accepted by observance of the PD activities that occur through the equipment’s life.

IV. SIGNAL DENOISING

In general PD doesn’t cause instant breakdown. It express the existence of a defect inside the insulation which might have an effect on its performance in an exceedingly long run. In the chapter explains regarding the denoising techniques that are secondhand to denoise the Partial discharge signals in an efficient manner. The noise is especially generate by pours and exposes that WT strategies displays best results compared to different filtering procedure by the signal to reconstruction error ratio (SRER) and reduction in noise level (RNL).

A. Wavelet Transform

In virtual signal processing and picture compression, wavelet is used and wavelet is a mathematical function. Firstly Wavelet compression is analysing a picture or image and secondly set of mathematical expressions is formed and then the receiver is used for decoded purpose. In recent years, Wavelet Transform (WT) has been adopted as an alternative algorithm for the analysis of non-stationary PD waveform. Comparing frequency/time-based filters, WT is more suitable for de-noising PD signals. In Wavelet, both time and frequency domains are used for analyse the signal and high and low-frequency components are used for analyse the sharp spikes in a signal and regains the originality of the signal.

B. Types of Wavelet Transform

- Daubechies Wavelet
- Coiflet Wavelet
- Biorthogonal Wavelet
- Symlet Wavelet
- Fejér-Korovkin Wavelet

IV. EVALUATED PARAMETERS

A. Signal to Reconstruction Error Ratio (SRER)

It is defined as the ratio of the power of the signal to the power of the noise. Equation (1) shows a SNR value, where $s(i)$ is the PD signal, $n(i)$ is the noise signal and $N$ the number of samples.

$$SRER(dB)=10\log_{10}\frac{\sum_{i=1}^{N} s^2(i)}{\sum_{i=1}^{N} n^2(i)} \quad (1)$$

B. Reduction in Noise Level (RNL)

RNL is determined by,

$$RNL=10\log_{10}\sum_{i=1}^{N} (Z(i) - Y(i))^2 \quad (2)$$

Where, $Z(i)$ is the noisy signal acquired, $Y(i)$ is the denoised signal and $n$ is the number of samples. Equation (2) shows a RNL value.

V. RESULT DISCUSSION

In this section, the results obtained within the limited period for completion of the project. Different type of defects are created in low tension cable. PD waveform is obtained from Partial Discharge meter. Normally PD signal contains noise, so this must be reduced because obtaining exact signal. The wavelet signal de-noising method is used for de-noising the PD signal with the help of MATLAB. The Signal to Reconstruction Error Ratio (SRER) and Reduction in Noise Level (RNL) are compared in different types of mother wavelets.

A. Partial Discharge Waveform in Pure Cable

![PD waveform for pure cable](image)

Fig. 7 shows a PD waveform for pure cable. Fig. 8 shows 3D image of pure cable. This PD waveform contains PD magnitude and noise signal. This noise signal must be eliminated to obtain the exact PD waveform. It can be done by different mother wavelets. Table I– VI shows a SRER and RNL values for different mother wavelets.
Measurement and Denoising of Partial Discharge Signal in High Voltage Cables using Wavelet Transform

**Fig. 8. 3D plot of pure cable**

**Table-I: SRER and RNL in SYM wavelet for pure cable**

| SYMLET | SRER     | RNL      |
|--------|----------|----------|
| 2      | 30.5154  | -64.5154 |
| 3      | 30.5944  | -64.5831 |
| 4      | 30.6982  | -65.0393 |
| 5      | 30.6121  | -64.7995 |
| 6      | 30.8418  | -65.0619 |
| 7      | 30.8353  | -65.5532 |
| 8      | 30.9579  | -65.6880 |

**Table-II: SRER and RNL in COIF wavelet for pure cable**

| COIF   | SRER     | RNL      |
|--------|----------|----------|
| 1      | 30.5474  | -64.5074 |
| 2      | 30.7885  | -65.2702 |
| 3      | 30.9288  | -65.7569 |
| 4      | 30.9947  | -65.8069 |
| 5      | 31.0573  | -65.9337 |

**Table-III: SRER and RNL in FK wavelet for pure cable**

| FK     | SRER     | RNL      |
|--------|----------|----------|
| 4      | 28.8955  | -62.1604 |
| 6      | 30.5802  | -64.3063 |
| 8      | 30.8378  | -65.0967 |
| 14     | 31.0779  | -65.8317 |
| 18     | 31.1380  | -65.9012 |
| 22     | 31.1290  | -65.865  |

**Table-IV: SRER and RNL in BIOR wavelet for pure cable**

| BIOR   | SRER     | RNL0     |
|--------|----------|----------|
| 1.1    | 28.2424  | -61.1567 |
| 1.3    | 28.4479  | -64.7975 |
| 1.5    | 28.6229  | -65.6319 |
| 2.2    | 30.8686  | -65.1237 |
| 2.4    | 30.9755  | -65.4383 |
| 2.6    | 31.0571  | -66.2663 |
| 2.8    | 31.1252  | -66.3126 |
| 3.1    | 29.7921  | -66.7652 |
| 3.3    | 30.8946  | -65.9157 |
| 3.5    | 31.0747  | -66.4418 |
| 3.7    | 31.1755  | -66.6615 |
| 3.9    | 31.2537  | -67.1663 |
| 4.4    | 30.7733  | -64.9053 |
| 5.5    | 30.5481  | -64.6345 |
| 6.8    | 30.9686  | -65.4784 |

**Table-V: SRER and RNL in DB wavelet for pure cable**

| DB     | SRER     | RNL      |
|--------|----------|----------|
| 1      | 28.2424  | -61.5167 |
| 2      | 30.3516  | -64.5154 |
| 3      | 30.5944  | -64.5831 |
| 4      | 30.5826  | -64.5672 |
| 5      | 30.7446  | -64.9545 |
| 6      | 30.8093  | -65.3544 |
| 7      | 30.8209  | -65.1979 |
| 8      | 30.8631  | -65.1739 |
| 9      | 30.8943  | -65.3601 |
| 10     | 30.9541  | -65.7902 |

**Table-VI: Comparison of all mother wavelets for pure cable**

| Mother wavelet | SRER     | RNL      |
|----------------|----------|----------|
| SYM 8         | 30.9579  | -65.6880 |
| COIF 4        | 30.9947  | -65.8069 |
| FK 18         | 31.1380  | -65.9012 |
| BIOR 3.9      | 31.2537  | -67.1663 |
| DB 10         | 30.9541  | -65.7902 |

Biorthogonal 3.9 gives a higher Signal to Reconstruction Error Ratio (SRER) and Reduction in Noise Level (RNL) comparing all the mother wavelets levels. Denoising PD waveform shown in Fig 9.

**Fig. 9. Denoised PD waveform for pure cable**
B. Partial Discharge Waveform in 2mm Cylindrical Void Cable

Fig. 10. PD waveform for 2mm cylindrical cable

Fig. 10 shows a PD waveform for 2mm cylindrical cable. Fig. 11 shows a 3D image of 2mm cylindrical cable. This PD waveform contains PD magnitude and noise signal. This noise signal must be eliminated to obtain the exact PD waveform. It can be done by different mother wavelets.

Table- VII: SRER and RNL in SYM wavelet for 2mm cylindrical cable

| SYMLET | SRER   | RNL       |
|--------|--------|-----------|
| 2      | 25.1162| -43.6249  |
| 3      | 25.8268| -44.8245  |
| 4      | 25.9971| -45.1695  |
| 5      | 25.5768| -44.7508  |
| 6      | 26.5681| -46.1530  |
| 7      | 26.6364| -46.3606  |
| 8      | 26.8183| -46.6292  |

Table- VIII: SRER and RNL in COIF wavelet for 2mm cylindrical cable

| COIF | SRER   | RNL       |
|------|--------|-----------|
| 1    | 26.0327| -44.7475  |
| 2    | 26.5524| -45.8373  |
| 3    | 26.7766| -46.4333  |
| 4    | 26.8967| -46.7712  |
| 5    | 27.1552| -47.1554  |

Table- IX: SRER and RNL in FK wavelet for 2mm cylindrical cable

| MOTHER WAVELET | SRER   | RNL       |
|----------------|--------|-----------|
| FK 4           | 24.0197| -42.3679  |
| 6              | 26.2398| -45.4070  |
| 8              | 26.4576| -45.9490  |
| 14             | 27.5437| -47.6539  |
| 18             | 27.4337| -47.4388  |
| 22             | 27.6052| -47.6383  |

Table- X: SRER and RNL in BIOR wavelet for 2mm cylindrical cable

| MOTHER WAVELET | SRER   | RNL       |
|----------------|--------|-----------|
| 1.1            | 23.5206| -41.5877  |
| 1.3            | 23.8639| -42.9348  |
| 1.5            | 24.1337| -43.3952  |
| 2.2            | 27.4788| -46.6830  |
| 2.4            | 27.8261| -47.6237  |
| 2.6            | 27.9752| -48.2761  |
| 2.8            | 28.1743| -49.0619  |
| 3.1            | 25.6263| -49.0624  |
| 3.3            | 26.8594| -46.2554  |
| 3.5            | 27.3555| -47.3379  |
| 3.7            | 27.5307| -48.3457  |
| 3.9            | 27.6372| -48.8992  |
| 4.4            | 27.7306| -46.0028  |
| 5.4            | 25.7715| -44.7542  |
| 6.8            | 27.1963| -47.0455  |

Table- XI: SRER and RNL in DB wavelet for 2mm cylindrical cable

| MOTHER WAVELET | SRER   | RNL       |
|----------------|--------|-----------|
| 1              | 23.5206| -41.5877  |
| 1.3            | 23.8639| -42.9348  |
| 1.5            | 24.1337| -43.3952  |
| 2.2            | 27.4788| -46.6830  |
| 2.4            | 27.8261| -47.6237  |
| 2.6            | 27.9752| -48.2761  |
| 2.8            | 28.1743| -49.0619  |
| 3.1            | 25.6263| -49.0624  |
| 3.3            | 26.8594| -46.2554  |
| 3.5            | 27.3555| -47.3379  |
| 3.7            | 27.5307| -48.3457  |
| 3.9            | 27.6372| -48.8992  |

Table- XII: Comparison of all mother wavelets for 2mm cylindrical cable

| MOTHER WAVELET | SRER   | RNL       |
|----------------|--------|-----------|
| SYM 8          | 26.8183| -46.6292  |
| COIF 5         | 27.1552| -47.1554  |
| FK 22          | 27.6052| -47.6383  |
| BIOR 2.8       | 28.1743| -49.0619  |
| DB 10          | 27.1088| -47.0654  |

Biorthogonal 2.8 gives a higher Signal to Reconstruction Error Ratio (SRER) and Reduction in Noise Level (RNL) comparing all the mother wavelets levels. Denoising PD waveform shown in Fig.12.
Measurement and Denoising of Partial Discharge Signal in High Voltage Cables using Wavelet Transform

Fig. 12. Denoised PD waveform for 2mm cylindrical void cable

C. Partial Discharge Waveform in 5mm Cylindrical Void Cable

Fig. 13. PD waveform for 5mm cylindrical cable

Fig. 14. 3D image of 5mm cylindrical cable

Table- XIII: SRER and RNL in SYM wavelet for 5mm cylindrical cable

| SRER | RNL  |
|------|------|
| 27.1424 | -52.7675 |
| 27.6807 | -53.7615 |
| 27.8171 | -54.0651 |
| 27.5537 | -53.8638 |
| 28.4060 | -54.7979 |
| 28.2737 | -54.6908 |
| 28.6812 | -55.1839 |

Table- XIV: SRER and RNL in COIF wavelet for 5mm cylindrical cable

| COIF | SRER | RNL  |
|------|------|------|
| 27.4997 | -53.3687 |
| 28.0916 | -54.3746 |
| 28.4693 | -54.8485 |
| 28.7301 | -55.1695 |
| 28.9346 | -55.4211 |

Table- XV: SRER and RNL in FK wavelet for 5mm cylindrical cable

| FK  | SRER | RNL  |
|-----|------|------|
| 4   | 25.4136 | -51.0291 |
| 6   | 27.8380 | -54.0548 |
| 8   | 28.0647 | -54.4072 |
| 14  | 29.1857 | -55.7715 |
| 18  | 29.3049 | -55.9937 |
| 22  | 29.1518 | -56.0307 |

Table- XVI: SRER and RNL in BIOR wavelet for 5mm cylindrical cable

| BIOR | SRER | RNL  |
|------|------|------|
| 1.1  | 29.3400 | -56.1901 |
| 1.3  | 25.2965 | -52.0608 |
| 1.5  | 25.4715 | -52.3467 |
| 2.2  | 28.4657 | -54.7439 |
| 2.4  | 28.8515 | -55.6651 |
| 2.6  | 28.9915 | -56.1389 |
| 2.8  | 29.1951 | -56.7561 |
| 3.1  | 27.3290 | -54.7122 |
| 3.3  | 28.5797 | -55.0712 |
| 3.5  | 28.8279 | -55.7775 |
| 3.7  | 29.0894 | -56.6805 |
| 3.9  | 29.2191 | -56.9328 |
| 4.4  | 28.3285 | -54.5797 |
| 5.5  | 27.4533 | -53.4232 |
| 6.8  | 28.9055 | -55.3686 |
In this work, cylindrical defects is imported into a 1.1 kV XLPE cable. The PD characteristics of cylindrical cavities with various void diameter have been experimentally investigated. In this planned technique, Wavelet Transform (WT) is employed to denoise the PD signal in a very more practical manner. By evaluating the two totally different parameters it's clearly shows that the suggested denoised technique has a worthy SNR and RNL values. The noise existence within the signal ought to be low solely within the case that the SNR worth ought to be higher. The RNL shows high worth, that describes however expeditiously the noise is eliminated from the PD signal. Among the five different mother wavelets, Biorthogonal (Bior) shows a better result to denoise the PD measured signal.

REFERENCES

1. Xiao Gu, Shuang He, Yang Xu, Youxiang Yan, Shuai Hoang Mingli Fu, “Partial Discharge Detection on 320 kV VSC-HVDC XLPE Cable with Artificial Defects under DC Voltage”, IEEE Transactions on Dielectrics and Electrical Insulation, Vol. 25, No. 3, pp. 939 – 946, 2018.

2. H.A.Illias, M.A.Tunio, A.H.A. Bakar, H.Mokhlis and G.Chen, “Partial Discharge Phenomena within an Artificial Void in Cable Insulation Geometry: Experimental Validation and Simulation”, IEEE Transactions on Dielectrics and Electrical Insulation, Vol. 23, No.1, pp. 451 – 459, 2016.

3. Hazlee Illias, George Chen and Paul L. Lewin, “Partial Discharge Behavior within a Spherical Cavity in a Solid Dielectric Material as a Function of Frequency and Amplitude of the Applied Voltage”, IEEE Transactions on Dielectrics and Electrical Insulation, Vol. 18, No.2, pp. 432 – 443, 2011.

4. Weiwai Li, Jianying Li, Guilai Yin, Shengtao, Li Jiankang Zhao and Benhong Ouyang, “Frequency Dependence of Breakdown Performance of XLPE with Different Artificial Defect”, IEEE Transactions on Dielectrics and Electrical Insulation, Vol.19, No. 4, pp. 1351 – 1359, 2012.

5. Yunfeng Xia,Xinning Song, Jianzong He, Zhidong Jia and Xilin Wang, “Simulation and partial discharge detection for typical defects of 10 kV cable the joint”, IET The Journal of Engineering, Vol. Iss.16, pp. 2856 – 2859, 2019.

6. Zhipeng Lei, Jiancheng Song, Muqin Tian, Xiaohuo Cui, Chuanyang Li and Minmin Wen, “Partial Discharges of Cavities in Ethylene Propylene Rubber Insulation”, IEEE Transactions on Dielectrics and Electrical Insulation, Vol. 21, No. 4, pp. 1647 – 1659, 2014.

7. A.B.J.M. Diesssen, J van Duivenbode and P.A.A.F.Wouters, “Partial Discharge Detection for Characterizing Cable Insulation under Low and Medium Vacuum Conditions”, IEEE Transactions on Dielectrics and Electrical Insulation, Vol. 25, No. 1, pp. 306 – 315, 2018.

8. M. Runde, O. Kven, H. Förster and N. Magnusson, “Cavities in Mass Impregnated HVDC Subsea Cables Studied by AC Partial Discharge Measurements”, IEEE Transactions on Dielectrics and Electrical Insulation, Vol. 26, No. 3, pp. 913 – 921, 2019.

9. H.Okubo, K.Kojima, F.Endo, K.Sahara, R.Yamaguchi, and N.Hayakawa, “Partial Discharge Activity in Electrical Insulation for High Temperature Superconducting (HTS) Cables”, IEEE Transactions on Dielectrics and Electrical Insulation, Vol. 15, No. 3, pp. 647 – 654, 2008.

10. S.Mousavi Gargar, P.A.A.F.Wouters, P.C.J.M.van der Wielen and E.F Steennis, “Partial Discharge Parameters to Evaluate the Insulation Condition of On-line Located Defects in Medium Voltage Cable Networks”,IEEE Transactions on Dielectrics and Electrical Insulation, Vol. 18, No. 3, pp. 868 – 877, 2011.

VI. CONCLUSION

Table- XVII: SRER and RNL in DB wavelet for 5mm cylindrical cable

| DB   | SRER   | RNL   |
|------|--------|-------|
| 1    | 24.8076| -50.1707 |
| 2    | 27.1424| -52.9675 |
| 3    | 27.6807| -53.7615 |
| 4    | 27.1056| -53.1968 |
| 5    | 27.6866| -53.9358 |
| 6    | 28.2244| -54.6420 |
| 7    | 28.3649| -54.7991 |
| 8    | 28.7259| -55.2119 |
| 9    | 28.6055| -55.1314 |
| 10   | 28.8486| -55.4171 |

Table- XVIII: Comparison of all mother wavelets for 5mm cylindrical cable

| MOTHER WAVELET | SRER   | RNL   |
|----------------|--------|-------|
| SYM 8          | 28.6812| -55.1839 |
| COIF 5         | 28.9346| -55.4211 |
| FK 18          | 29.3049| -55.9937 |
| BIOR 3.9       | 29.2191| -56.9328 |
| DB 10          | 28.8486| -55.4171 |

Biorthogonal 3.9 gives a higher Signal to Reconstruction Error Ratio (SRER) and Reduction in Noise Level (RNL) comparing all the mother wavelet levels. Denoising PD waveform shown in Fig. 15.

![Denoised PD waveform for 5mm cylindrical void cable](image)

The proposed method WT which overcomes the problem (i.e) noise present in the measured PD signal. Wavelet Transform approach is used for noise reduction goal, it recovers the novelty of the signal after denoising. To evaluate the effectiveness of the PD signal denoising Wavelets. The statistical parameters like SRER and RNL are computed, compared and tabularized in Tables VI, XII, XVIII for all cases. Biorthogonal Mother Wavelet produces the better result among other Mother wavelets.
Measurement and Denoising of Partial Discharge Signal in High Voltage Cables using Wavelet Transform

AUTHORS PROFILE

S. Madhupriya received BE Degree in electrical and electronics engineering in 2018 at the National Engineering College, Kovilpatti. She is studying final year high voltage Engineering in National Engineering College, Kovilpatti. Her area of interest is partial discharge.

Dr. R. V. Maheswari received BE Degree in electrical and electronics engineering in 2000 at the Government College of Engineering, Tirunelveli, ME (high voltage engineering) in 2008 at the National Engineering College and PhD (electrical engineering) from the Anna University, India in 2015. Presently, she is working as Professor in EEE Department of the National Engineering College, Kovilpatti. She has more than 13 years of teaching experience in engineering institutions. She has published twenty papers in international conferences and eight international journals. She is an active member of IEEE, IE (I) and ISTE. Her research interests are characteristics of partial discharge, numerical analysis, pattern recognition and modeling of partial discharge.

Mr. B. Vigneshwaran received his B.E. and M.E. Degree from P.S.R. Engineering College, Sivakasi and National Engineering College in 2011 and 2013 respectively. His area of specialization is High Voltage Engineering. At present he is an Assistant Professor (Senior Grade) in EEE Department of National Engineering College. Totally he has published 9 papers in International Conferences and 8 papers in International Journal. He is an ISTE member His research interests are Characteristics of Machine learning, Partial discharge pattern analysis and FEM.