© 2018 IJSRST | Volume 4 | Issue 3 | Print ISSN : 2395-6011 | Online ISSN: 2395-602X

National Conference on Advances in Engineering and Applied Science (NCAEAS)
29th January 2018
Organized by : Anjuman College of Engineering and Technology (ACET) Nagpur, Maharashtra, India, In association with
International Journal of Scientific Research in Science and Technology

Detection of inrush current using Wavelet Transform and Artificial Neural Network (ANN)

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ABSTRACT

Transformer Starting current's initial cycle i.e inrush currents are high magnitude, harmonic-rich currents generated when transformer cores are driven into saturation during energization. In this paper an effective method of detecting of inrush current in distribution transformer based on wavelet transform is presented. Using this method inrush current can be distinguished from other currents. Inrush current data and other transients are obtained by simulation using MATLAB. Results show that the proposed procedure is efficient in identifying inrush current from other events.

I. INTRODUCTION

M. Gong.et.al. [1] Presents method of transformer differential protection. As inrush current causes many faults in transformer. WT and neural network is used to analyze the single phase signals of inrush current. The simulation of short circuit current and inrush current is done by PSCAD/EMTDC software. A 360MVA, 220/35kv is used. Generally the action time of protection is approximately 14ms where wavelet neural network analyze it in 10ms.

M. Naderi.et.al. [2] Introduces wavelet transform for identifying partial discharge signals. It is very complicated task to identify partial discharge signals in transformer. 66KV/25MVA transformer with fully interleaved winding and connected tap winding is used as a test object. This method gives partial discharge distortion in a level which gives chance of applying the result in de-noised signals to localize partial discharge in transformer winding.

I. Wahyudi.et.al. [3] Develops wavelet transform for filtering harmonic currents and the results are classified by using probabilistic neural network (PNN). In this method single phase power transformer 25KVA dry-type transformer, voltage rating is 7200V /240V /120Vand the frequency is 60Hz with a load that varies is used. Wavelet transform separates fundamental signal and noise signal whereas the PNN does classification of each transformer.

O.A. Mohammad.et.al. [4] Improved method for understanding the behavior of harmonic currents and dc currents using wavelet packet transform algorithm (WPT). This method allow physical representation of the behavior of nonlinear magnetization and frequency dependence of the transformer. In this technique 3-phase, 150-KVA,

240/120 V, 60 Hz transformer is used. An ability to quantify different types of disturbances is done by concluded WPT analysis.

H. Ashfaq and M.N. Quadri [5] Introduces wavelet transform which analyze type of fault as well as approximate change in wave shape causes by fault occurrences. The types of fault are classified on the basis of characteristics nature. In this method generator and 3-phase power transformer rating is 30 MVA, 132 KV and 25 MVA, 132/66 KV respectively is used. The wavelet transform has ability to extracted information from transient signals simultaneously in the time and frequency domain.

E. Zahab.et.al. [6] Proposed method for incipient fault in power transformer which cannot be done by traditional protection. In this method simulation is done by using Alternative Transient Program (ATP) for recognizing incipient fault in transformer. Wavelet packet transform (WPT) is develop to measure RMS value of the harmonics content in a signal. The 3-phase power transformer which has 72/13.8 KV, 66 MVA, 50 Hz rating is used for simulation work.The proposed technique can be applied to any power transformer without using hardware.

Y-Y Hong and P-C Chian [7] illustrates the application of wavelet transform for detectingfault current occurrence time and recognizing all saturation periods in Current Transformer (CT). The simulation work is carried out on MATLAB/SIMULINK software. In this method the sampling rating of transformer frequency is 7680Hz. This method reduces training time as the limited sample points per cycle are used as inputs for MFNNs. The online time of computation is reduces.

B.L. Nayak [8] describes Discrete Wavelet Transform (DWT) for classifying the fault current occurring in transformer. The simulation is done by using MATLAB-SIMULINK software. The decomposition and reconstruction is straightforward. This method reduces commutating time as well as memory space.

M.M. Ansari.et.al. [9] Presents Discrete Wavelet Transform (DWT) for characterizing and discriminating the transient arising from magnetization and inter-turns fault in transformer. The single phase transformer of the rating 2KVA, 230Vis used in this method. This method provides predictive maintenance to the transformer.

M.S. Naderi.et.al. [10] Shows a technique for extracting Partial Discharge (PD) signals. The technique is employed for evaluating electrical measured partial discharges by wavelet transform. The 66KV, 25MVA fully interleaved winding of a power transformer is used in this system. This method is achieving acceptable levels of noise suppression.

K. Prakasam.et.al. [11] Introduces the method of very fast transient over voltages of 132KV caused by switching operation. The simulation work is carried out by MATLAB software. 132KV power transformer is used in this study. The error evaluated by using both conventional as well as wavelet transform is 2.66% in magnitude of VFTOs and 5.3% in rise time.

F. Zeng.et.al. [12] Describes the Empirical Mode Decomposition (EMD) which discriminating the inrush current from internal fault of power transformer. The three phase power transformer is used in this technique. This method is convenient for distinguishing fault conditions and normal air drop.

J. Azarakhsh [13] represents the differential protection technique used in the power transformer. The learned decision tree is used for detecting type of fault. The simulation of power system and differential relay is carried out using PSCAD and MATLAB. In this technique 3- phase, 230KV, 50Hz transformer is used. The design relay has high speed and good performance which is essential for protection of power transformer. The time of detecting fault is few milliseconds and its maximum time of fault detecting is less than 10 milliseconds.

S.R. Paraskar.et.al. [14] States the algorithm for inrush current and fault using artificial neural network (ANN) in transformer. The technique used to identify fault in transformer since it has better monitoring capability. The location of fault is determined by discrete wavelet transform (DWT) and ANN. This method is study by using 220V, 2MVA, 50Hz single phase transformer is used. ANN takes less than one cycle for identifying the events.

K. Ramesh and M. Sushma [15] Presents the fault classification in a transformer. The technique applied wavelet transform. 138 KV, 50 Hz, three phase power transformer is simulated using MATLAB. The proposed method reduces data size without losing its distinguishing characteristics.

S.R. Huang.et.al. [16] Discusses the phenomenon of fault current and inrush current in transformer. This method presents technique for identifying fault current as well as inrush current in transformer by using Jiles-Atherton theory. In this technique 3-phase 11KV /20MVA transformer is used. The proposed method shows difference between inrush current and incipient fault current.
Omar A.S.Youssef[17] Discriminates between faults and inrush current in transformer. This paper presents the development of a wavelet based scheme , for distinguishing between transformer inrush currents and power system fault current by using MATLAB. A 132/l 1 kV, transformer connected to a 132 kV power system were simulated using the EMTP. The proposed scheme proved to be reliable , accurate and fast.

J. Pihler, B. Grcar.et.al. [18] suggests the improvement of power transformer protection using Artificial Neural Network. The paper suggests the possibility of improving digital power transformer protection. ANN was included in the protection algorithm as an extendon of the existing methods, which improved the reliability of the protection operation. The paper presents the digital protection algorithm completed in this way and the laboratory equipment by means of which experimental results were obtained. The results confirm faster and more reliable recognition of transfor- mer inrush, as well as satisfactory reconstruction of the distorted secondary CT currents.

G.Mokryani , P.Siano,A.Piccolo [19] suggest the detection of inrush current by using wavelet transform and probabilistic Neural Network. The paper had an efficient method for detection of inrush current from other transient currents.

Inrush current data and other transients are obtained by simulation using EMTP program. Results show that the proposed procedure is efficient in identifying inrush current from other events.

Suri Babu Miriyala .et.al [20] suggests the protection of power transformer from various faults. The protection is required for power transformers

i.e. mainly against inrush currents, internal faults and external faults.

Identification of transients is very fast and accurate the research proposes to develop a new wavelet method to identify inrush currents to distinguish it from power system faults. The proposed algorithm extract faults and inrush generated transient signals using wavelet transform. The output signal of the wavelet transform classifies the transients.

S. A. Saleh.et.al [21] suggest the protection of transformer by using wavelet transform. This paper introduces a novel current diagnosis and protection technique, which is based on a Wavelet Packet Dansform (WPT). An experimental setup is developed and the proposed WPT technique is tested on-line on a three-phase laboratory power transformer. The WPT technique performed successfully by identifying different currents including magnetizing inrush, normal current (through- fault) and different internal faults currents.

Anupam Sinha .et.al[22] suggest the method of differentiating inrush current and other internal current. The false tripping of the relay takes place so to avoid it some other methods which can also be used for proper distinction between inrush current and internal fault current are highlighted in this paper. Some other methods were highlighted and conclusion were took out.

J.P. Patra [23] discusses the transformer magnetizing fault detection in power transformer . This paper discusses the different types of inrush phenomenon in power transformer. This paper shows study fault pattern by the aid of world's most popular environment, that is MATLAB- SIMULINK and also discusses some of its advantages.

Mrs. S. Poornima[24] Compares of CWT & DWT based Algorithms for protection of power transformer. The paper shows the development of CWT and DWT based preprocessing units to extract distinguishing attributes from inrush and internals fault signals. Proposed scheme in paper achieves proper classification with high discrimination rate and least error, avoiding false tripping of power transformer.

M. Mujtahid Ansari.et.al[25] Paper shows for Fault Diagnosis in Transformer by Discrete Wavelet Transform. The detection method can provide information to predict fault ahead in time so as that necessary corrective actions are taken to prevent outages and reduce down time. Tests are performed on 2KVA, 230/230Volt custom built single phase transformer. The results are found using Discrete and conclusion presented.

YU-PING LU.et.al[26] Paper shows magnetizing inrush detection in digital differential protection for large transformer. The paper based onmulti-condition restraint which introduces voltage features as a criterion .The results show the advantages in comparing with traditional second harmonic restraint method. This intelligent scheme can meet the requirements for large transformer protection.

K. Sheshyekani.et.al[27] Paper shows the discrimination between fault and inrush current. the discrete wavelet transform has been used to extract the energy of the signal at 15 resolution levels.These paper shows energy profile of wavelet decomposition levels leads to the accurate discrimination between fault and inrush current.

MA Jing.et.al[28]Paper shows the discrimination between fault and inrush current using Mathematical Morphology. the inrush current and short circuit current caused by internal fault on the basis of sudden changes detection using novel morphological gradient (NMG), transient current signals are then extracted by use of morphological opening and closing transform.

The results indicate that the proposed technique can also deal with the sampled data contaminated with various kinds of noises and DC components and is stable during internal faults with external shunt capacitance in a long EHV transmission line.

Xiangning Lin.et.al[29] This Paper shows the identification of inrush current. The identification is done by wavelet packet algorithm transform. Test results with the sampled data from r prototype device on a dynamic power system model verify the effectiveness of the proposed scheme.

S.Sudha.et.al[30] The paper suggest the relaying for protection of power transformer. The wavelet transform is applied first to decompose the current signals of the power transformer into a series of detailed wavelet components. A typical 750 MVA, 27/420KV, /Y power transformer connected between a 27KV source atthe sending end and a 420KV transmission line connected to an infinite bus power system at thereceiving end were simulated using PSCAD/EMTDC software.

II. CONCLUSION

The work carried out in this paper has been concentrated on implementing an effect algorithm for the classification of faults in the transformer. Wavelet analysis, an entirely new approach is presented for the detection of inrush current in transformer. The wavelet transform is performed on different currents recorded for various types of faults.

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