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Condition Monitoring of Power Cable Using Park Vector Approach

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ABSTRACT: This paper proposes a continuous condition monitoring technique of power cables used in transmission and distribution system. Nowadays for power transmission cables are used mostly. Fault in cables can affect the power transmission and decrease the reliability of the system. This proposed topology is able to monitor the total health condition of a cable remotely. This proposed system can monitor the health condition of the cable from the sending end. Mainly faults occur in power cable due to insulation failure. This proposed system can be able to locate the unhealthy portion of the cable from the sending-end. This process is able to protect the cable from fault. To determine the health condition of a long cable this remote condition monitoring system is highly efficient. This proposed system is able to determine the position of unhealthy portion of the cable.

KEYWORDS: Park vector, power cable, remote health monitoring.

I. INTRODUCTION

Now days for power transmission and distribution power cables are used more. In three phase power transmission three core cables are preferred. Cable is preferred more than other conductors due to their advantages. Cable faults are the major problem in transmission networks which causes the discontinuity in supply system. To avoid unwanted breakdown testing and maintenance is needed. A fault occurs due to decrease in the health condition of power cable. From the health condition of the cable it can be determined for how much time the cable can be used. Health condition can also help us to plan about the maintenance schedule of the cable. Cable health condition decreases due to its ageing effect. Due to environmental effect and other effects health condition of the cable may not be same throughout the entire portion. In a particular portion where health condition decreases more, the cable there has a major chance of fault. In a power cable conductors are separated by insulator which creates a capacitor. Due to ageing effect capacitance changes and insulation resistance decreases which causes increase of leakage current. By using a condition monitoring technique it is possible to determine the leakage current in different location in cable which can predict about the health condition of the cable. By increasing the leakage current heat increases which decreases the health condition of the cable and fault occurs. This proposed topology is able to detect the location where the health condition is not good. This proposed system also effects the type of leakage .A remote condition monitoring technique is proposed which can monitor the total cable from the sending end. From the health condition of the cable maintenance schedule can be determined. Another advantage of the system is that it does not need any kind of breakdown to determine the health condition of the cable. After getting data from the system it is possible to get the idea about the location where leakage current is more, and the cable should be observed in that portion to get the actual location. Park vector transform is used to generate the output pattern. Park vector transform converts three phase current components of sending end I_a , I_b and I_c into two components I_d and I_q . Graphical representation of these two components gives a pattern .By comparing the pattern with the ideal pattern health condition can be determined.

II. HEALTH CONDITION OF THE CABLE

For power transmission three core cables are used. In these type of cable each conductor are separated by insulating material by which capacitor forms. There are some cables mainly used in underground transmission which has a metal sheath. These types of cable also form a capacitance between conductor and ground which is shown below. Dielectric strength and insulation resistance of the cable decreases due to ageing effect. Due to ageing effect dielectric constant of

the insulating material decreases which causes the decrease in breakdown voltage. Due to environmental effect and surroundings effect, breakdown voltage and insulation resistance is not same in the total length of the cable. In different location cable health condition decreases more which causes the flow of a high amount of leakage current and heat generation. For that reason faults occur in the cables. In this figure below C_a, C_b, C_c are the capacitance between conductor and ground. C_{ab}, C_{bc}, C_{ca} are the capacitance between the line conductors. When any health issue is found all the capacitance may not be same which will cause an unequal leakage current.

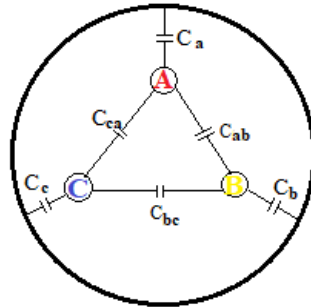


Fig. 1. Capacitance of the three core cable

In the figure given below R_a, R_b, R_c are the insulation resistance between line and ground. R_{ab}, R_{bc} and R_{ca} are the insulation resistance between the line conductors. When the cable health condition is not good all the insulation resistance will not be equal which will cause an unbalance leakage current.

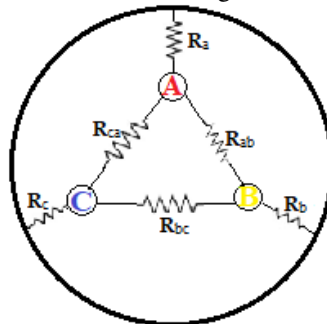


Fig. 2. Insulation resistance of three core cable.

III. WORKING PRINCIPLE

By using this proposed topology it is possible to monitor the health condition of the cable from the sending end. Current of the three phases should be measured at the sending end. These three current components should be sent for park transformation which will convert it in two components. After plotting the two components on graph a pattern should be generated. For health issue in different location and different phases different types of pattern should be generated. By comparing the generated pattern with the ideal pattern it is possible to find out the health issue and probable location. To know about the types of health issue different types of health data of the cable is needed which can be generated from a simulation. This topology is highly efficient to find asymmetrical faults. If any health issue is found, by planning and executing a proper maintenance it is possible to save the system from unwanted breakdown. In this topology it is possible to determine the health condition of the cable when it is loaded.

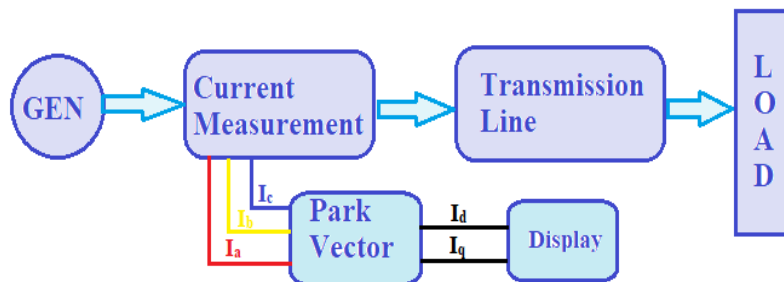


Fig. 3. Block diagram of the proposed system.



IV. PARK VECTOR APPROACH

Figures Park vector is an algorithm used in fault analysis in three phase circuit. Park vector is highly efficient to convert three components into two components. This algorithm is mainly used to analyse the unbalanced fault current. In this project Park vector converts three phase current components in two components. When the two components are plotted on a graph it looks like a circle in ideal condition. After getting non-uniformness in leakage current pattern changes.

$$I_d = \sqrt{\frac{2}{3}} I_a - \frac{1}{\sqrt{6}} I_b - \frac{1}{\sqrt{6}} I_c$$

$$I_q = \frac{1}{\sqrt{2}} I_b - \frac{1}{\sqrt{2}} I_c$$

Where, I_d and I_q are the two components of park transform which are generated from the three phase current components of sending end I_a, I_b and I_c respectively.

By plotting the value of these two current components, I_d and I_q on X axis and Y axis respectively a pattern is generated which can say about the condition of the cable. For leakage current in different location and different phase's generated pattern should be different.

V. RESULT ANALYSIS

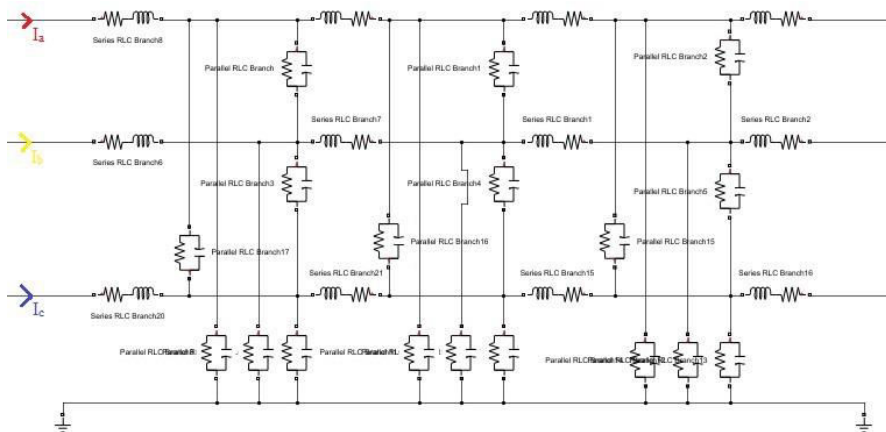


Fig. 4. Equivalent network of the cable

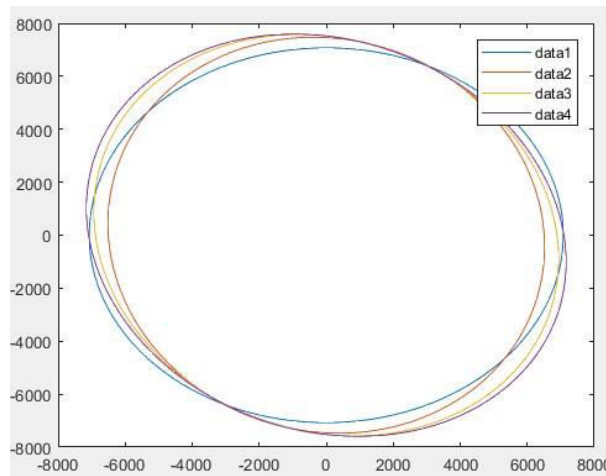


Fig. 5. Leakage between Phase A and Phase B

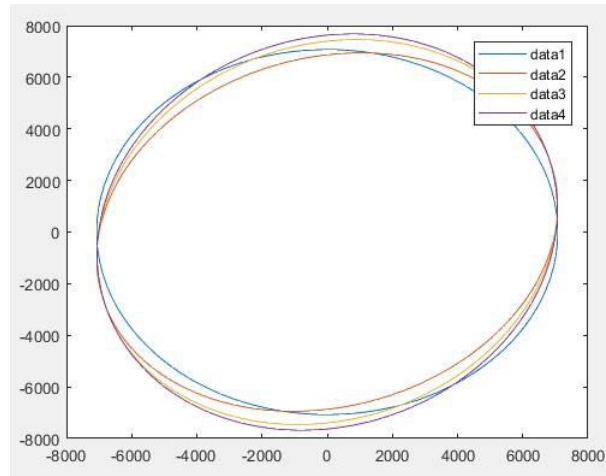


Fig. 6. Leakage between phase B and phase C

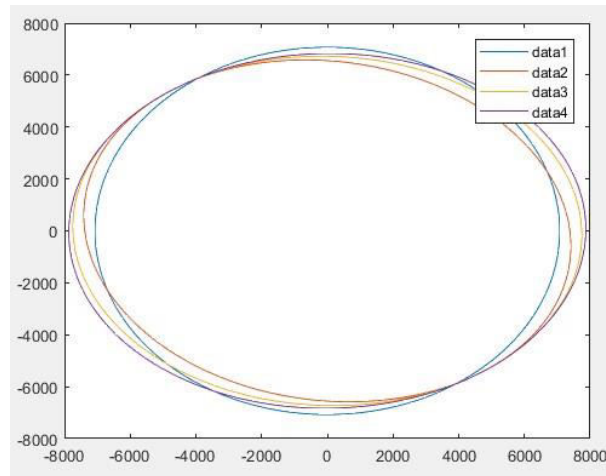


Fig. 7. Leakage between phase A and phase C

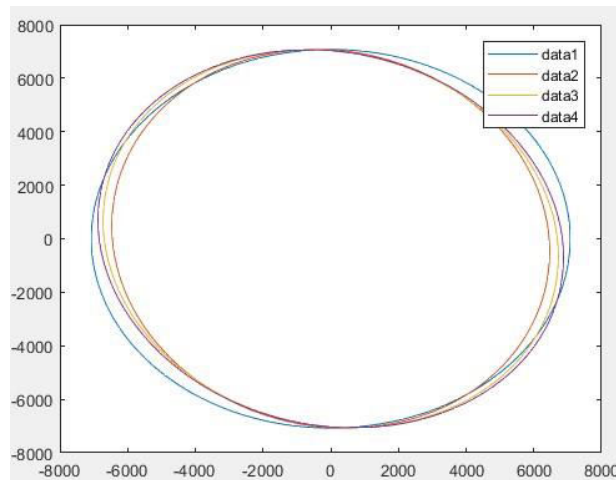


Fig. 8. Leakage between phase A and Ground

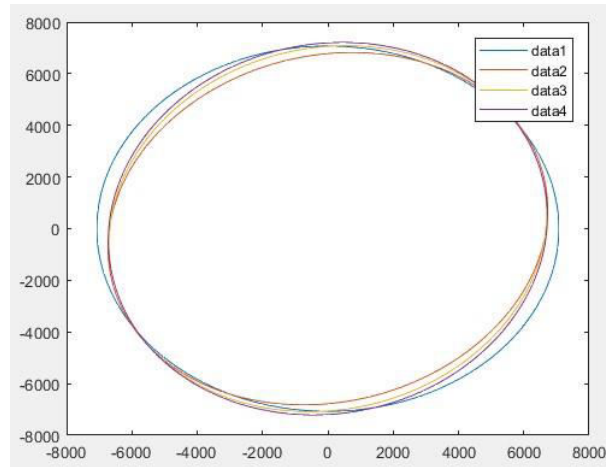


Fig. 9. Leakage between phase B and ground

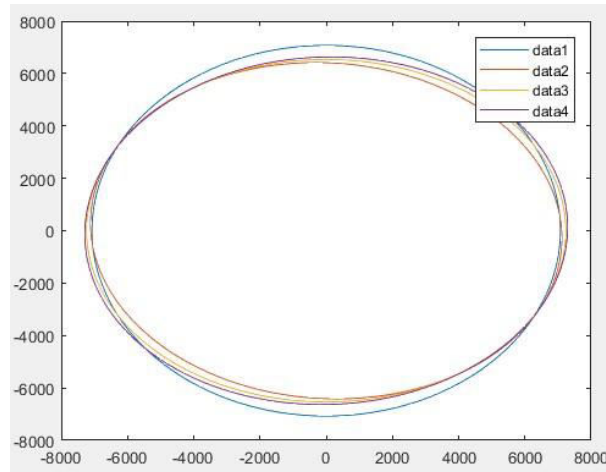


Fig. 10. Leakage between phase C and ground.

An equivalent network of a cable as shown in Fig.4 is designed in MATLAB Simulink model. Network is designed by series combination of resistance and inductance and at different location it is shunted by Parallel R-C branch. Parallel capacitor is used to represent the capacitance of the cable and parallel resistance is used to represent the insulation resistance of the cable. Change in parallel R-C branch impedance change the leakage current. For this simulation purpose to represent the unhealthy condition of the cable both of the capacitance and insulation resistance are decreased. This network is supplied from a three phase AC source and at the receiving end of the network a load is connected. With the help of park vector approach at the sending end this types of pattern is generated for different health condition. From the simulation result it has been observed that for leakage in different phases and different location different types of pattern is generated. In the above mentioned output figures, data2, data3 and data4 represents the unhealthy condition of sending end, mid-point and receiving end respectively and data1 represent the pattern of a healthy cable. From this pattern, types of health issue and location can be determined.

VI. CONCLUSION

This paper proposes a condition monitoring technique of a power cable which is capable to determine the health of the cable. This topology is introduced by the Park vector approach. This is a remote monitoring system which can say about the health condition of the cable. By using the proposed topology it is possible to avoid the unwanted breakdown and it can also identify the unhealthy portion of the cable. This topology is highly efficient when leakage current is not uniform. To determine the health issue we have to compare the generated pattern with different pattern generated by simulation. By adding Artificial Intelligence it is possible to make a system which can automatically say about % of



health and location of unhealthy portion of the cable. If leakage current is uniform then this topology will not be able to find out the health condition of the cable.

REFERENCES

- [1] Anirban Giri, BarishMitra, “Condition Monitoring and Faulty Insulator Locating using Park’s Transformation”, International Research Journal of Engineering and Technology (IRJET), Volume: 06 Issue: 11, 2019, pp.-1641-1644.
- [2] Matthew S. Mashikian, Rajeev Bansal, Robert B. Northrop, “LOCATION AND CHARACTERIZATION OF PARTIAL DISCHARGE SITES IN SHIELDED POWER CABLES”, IEEE Transactions on Power Delivery, Vol. 5, No. 2, 1990, pp.-833-839.
- [3] Ammar Anwar Khan, Nazar Malik, Abdulrehman Al-Arainy, SaadAlghuwainem, “A Review of Condition Monitoring of Underground Power Cables”, IEEE International Conference on Condition Monitoring and Diagnosis, Bali, Indonesia, 2012, pp.-909-912.
- [4] Neelam Turk, “Fault Diagnosis Using Park’s Vector Approach”, International Journal of Electrical and Computer Engineering, Volume 8, Number 1, 2016, pp. 7-11.
- [5] Tarlochan S. Sidhu, “Detection of Incipient Faults in Distribution Underground Cables”, IEEE TRANSACTIONS ON POWER DELIVERY, VOL. 25, NO. 3, 2010, pp.1363-1371.
- [6] Smit, J.J.; Gulski, E., "Advanced condition assessment of high voltage power cables", In the Proceedings of 2005 International Symposium onElectrical Insulating Materials, Vol. 3, 2005. PP. 869-872.



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