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Transmission Line Fault Detection on the basis of Hilbert Huang Transform

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ABSTRACT

In this paper, Hilbert change based blame recognition procedure has been proposed for the insurance of three stage transmission line incorporated with wind cultivate. The execution of the proposed plot has been tried under different blame conditions for with variety in different blame parameters like blame compose, blame area, blame protection, blame origin time and ground protection.

Keywords—Wind farm connected transmission lines; Hilbert transform.

I. INTRODUCTION

X. L. Zhang et al. [1] proposed Hilbert huang transform based three phase transmission line fault location scheme. Empirical mode decomposition has been used for extracting the intrinsic mode function (IMF) components of travelling wave and the Hilbert transform has been applied for obtaining the instantaneous frequency changing time of each IMF. Sanujit Sahoo, Papia Ray, B. K. Panigrahi and N. Senroy [2] developed an algorithm with the combination of DWT and FNN for the exact fault location on transmission line. Varma R K Bhupatiraju and Ramana Rao V Pulipaka [3] proposed a complete wavelet based protection scheme for the protection of asymmetrical teed transmission networks. V. J. Pandya and S. A. Kanitkar [4] developed an algorithm for the protection of series compensated transmission line using wavelet transform. S. M. A Saleem and A. M. Sharaf [5] proposed a relaying scheme based on a travelling wave which has been used for the detection of arching faults on a series compensated transmission line. The proposed algorithm utilizes wavelet transform based MRA approach for the ultra high speed directional protection of series compensated transmission line. Joe-Air Jiang et al. [6] presented synchronized PMU (phasor measurement units) based digital relaying algorithms for the protection of un-transposed DCTL. EMTP-ATP software has been used for simulating a 345 kV, 60 Hz, 100 km long un-transposed DCTL. H. Khorashadi-Zadeh [7] proposed ANN based fault detection, classification and faulted phase selection scheme for the protection of DCTL. EMTDC software has been used for simulating 230 kV, 100 km long DCTL. Zhiqian Q. Bo et al. [8] proposed a BO (balanced operation) scheme for non-communication protection of DCTL. By using proposed technique, the operation of remote-end circuit breaker can be detected and controlled by utilizing sequence and superimposed signals. Tests were conducted on a 275 kV DCTL test system. Lengths of lines 1 and 2 are 100 km and 80 km.

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In this paper, Hilbert-transform has been used for the protection of series compensated transmission line using Hilbert transform. The proposed scheme has been checked at different fault locations with different fault resistances and fault inception angles.

II.SIMULATION MODEL

The simulation model considered constitutes 400 kV, 50 Hz series compensated transmission line of 200 km length transmitting power through a 200 km. A wind farm consisting of five wind generators is connected at the receiving end of a transmission line. The simulation model is simulated in MATLAB software. Fig. 1 shows the proposed model.

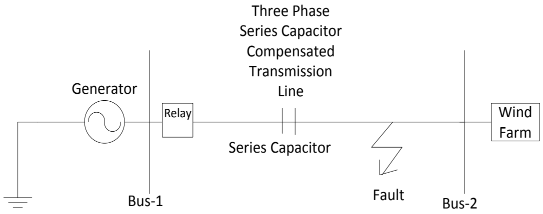

Fig. 1. Proposed simulation model

I. HILBERT TRANSFORM

The Hilbert transform can be defined as shown in equation-1 below.

$$H\{f(t)\} = -\frac{1}{\pi}\int_{-\infty}^{+\infty} f(\tau)\,\frac{d\tau}{\tau - t} = \qquad (1)$$

II. PROPOSED SCHEME

In the proposed work, Hilbert transform is used for fault detection by obtaining Hilbert transform coefficients of three phase current. A fault is detected when the magnitude of Hilbert transform coefficient of faulted phase is larger than the magnitude of Hilbert transform coefficient of an un-faulted phase. The proposed fault detection scheme is shown in Fig. 2.

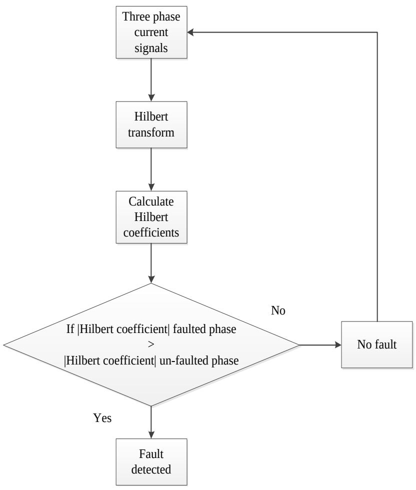

Fig. 2. Proposed technique

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III.TEST RESULTS

3.1Test results for fault type variation

The performance of the proposed scheme is checked for fault type variation by simulating test system for various fault cases. The three phase current during phase-‘B-g’ fault at 100 km from bus-1 is shown in Fig. 3. Hilbert coefficients of three phase current during phase-‘B-g’ fault are shown in Fig. 4. Fig. 4 depicts the process of fault detection using Hilbert transform during phase- ‘B-g’ fault occurring at 100 km from bus-1 with $R_f = 5\Omega$ and $R_g = 10\Omega$. The performance of the proposed scheme is ensured for various fault types occurring at 100 km from bus-1 with different R_f, R_g and FIT.

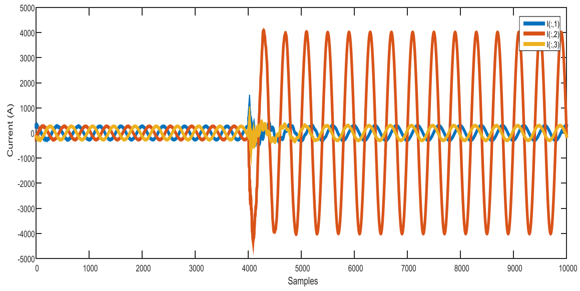

Fig. 3. Three phase current during phase-‘B-g’ fault

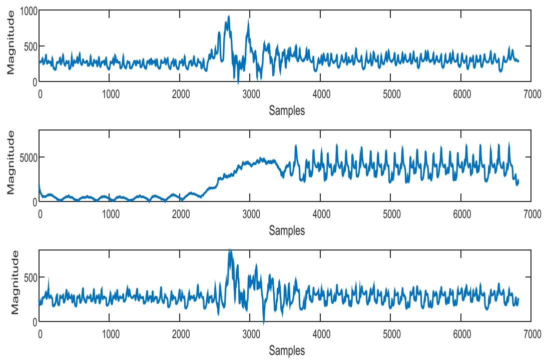

Fig. 4. Hilbert transform coefficients of three phase current during phase-‘B-g’ fault

3.2Test results for fault location variation

The three phase current during phase-‘BC-g’ fault at 50 km from bus-1 is shown in Fig. 5. The Hilbert coefficients of three phase current during phase-‘BC-g’ fault occurring at 50 km from bus-1 are shown in Fig. 6. Thus the proposed scheme is tested by generating faults on transmission line at different locations from bus-1.

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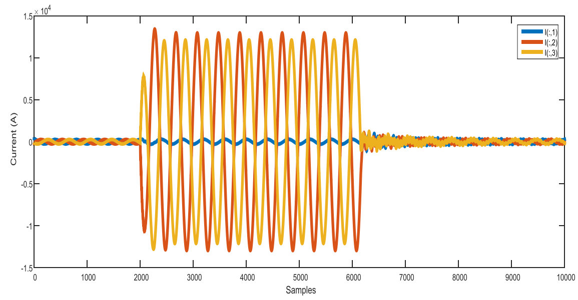

Fig. 5. Three phase current during phase-‘BC-g’ fault at 50 km from bus-1

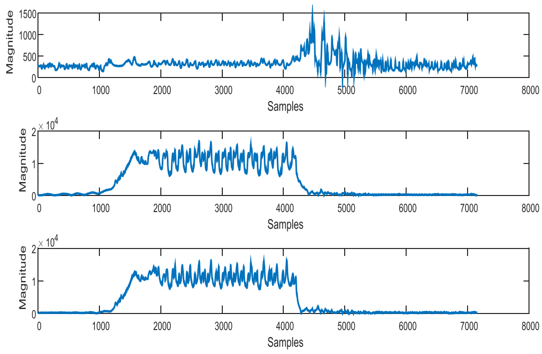

Fig. 6. Hilbert transform coefficients of three phase current during phase-‘BC-g’ fault at 50 km from bus-1

3.3Test results for fault resistance variation

The three phase current during phase-‘C-g’ fault at 100 km from bus-1 with $R_f = 30\Omega$ is shown in Fig. 7. Hilbert coefficients of three phase current during phase-‘C-g’ fault are shown in Fig. 8. The method of fault detection by means of Hilbert transform during phase-‘C-g’ fault happening at 100 km from bus-1 with $R_f = 30\Omega$ can be seen in Fig. 8. Thus the performance of the proposed scheme is inspected for different fault resistances.

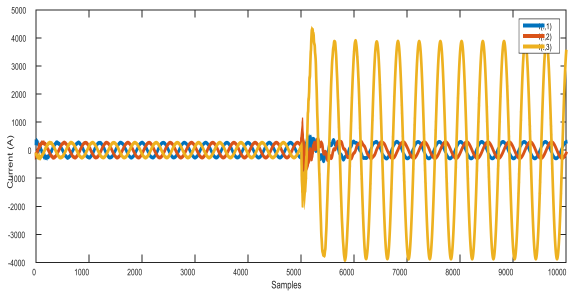

Fig. 7. Three phase current during phase-‘C-g’ fault at 100 km from bus-1 with $R_f = 30\Omega$

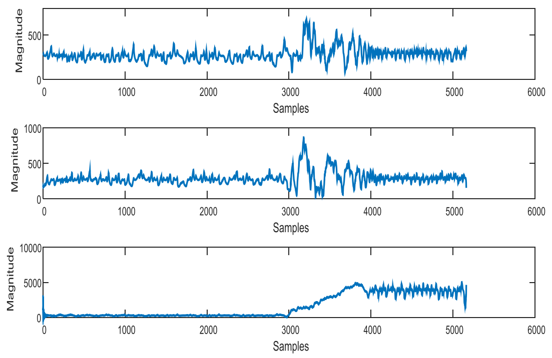

Fig. 8. Hilbert transform coefficients of three phase current during phase-'C-g' fault at 100 km from bus-1 with $R_f = 30\Omega$

3.4Test result for ground resistance variation

The three phase current for the duration of phase-'B-g' fault at 150 km from bus-1 with $R_g = 45\Omega$ is shown in Fig. 9. The process of fault detection by means of Hilbert transform for the period of phase-'B-g' fault occurring at 150 km from bus-1 with $R_g = 45\Omega$ can be seen in Fig. 10. The performance of the proposed scheme is examined up for quite a few ground resistances with different values of R_g.

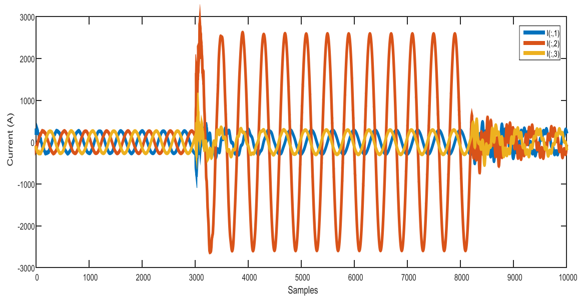

Fig. 9. Three phase current during phase-'B-g' fault at 150 km from bus-1 with $R_g = 45\Omega$

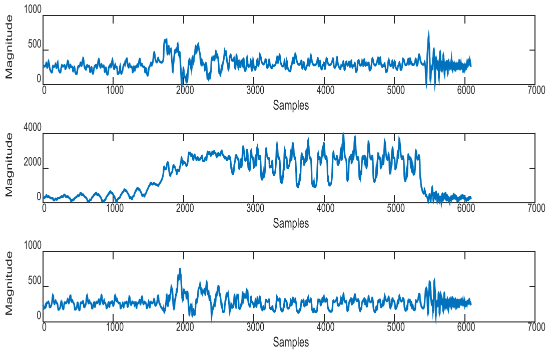

Fig. 10. Hilbert transform coefficients of three phase current during phase-'B-g' fault at 150 km from bus-1 with $R_g = 45\Omega$

IV.CONCLUSION

This paper presented fault detection method for the protection of wind farm connected three phase series compensated transmission line using Hilbert transform. The Hilbert transform performance is tested at different fault locations. Based on simulation results it is concluded that proposed technique perfectly detects all types of faults.

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