A new method for arcing fault location using discrete wavelet transform and wavelet networks

Sadegh Jamali* and Navid Ghaffarzadeh†

Centre of Excellence in Power Systems Automation and Operation, School of Electrical Engineering, Iran University of Science and Technology, Tehran, Iran

SUMMARY

This paper presents a new method for arcing (transient) fault location by combining discrete wavelet transform (DWT) and wavelet networks (WNs). The single-end relaying point voltage and current waveforms (captured with a sampling rate of 2.5 kHz) are de-noised by DWT to obtain a higher signal-to-noise ratio. The feature vectors contain the magnitudes of the three phase post-fault voltage and current fundamental frequency phasors obtained by DWT. The feature vectors for different arcing fault conditions are applied to WN for training and testing purposes. Although the prime aim of the proposed method is arcing fault location, it can also be applied for permanent faults. The accuracy of the proposed method has been tested and verified under various fault conditions on a 400 kV overhead line using the Electro-Magnetic Transient Program (EMTP) software package. Performance of the new method has also been compared with several existing methods under similar fault conditions, and the test results show better accuracy of the proposed method. Copyright © 2011 John Wiley & Sons, Ltd.

key words: fault location; discrete wavelet transform; wavelet networks; arcing faults; transmission line

1. INTRODUCTION

Statistics show that between 70% and 90% of fault on overhead power lines are transient (arcing), which more than 90% of them are single phase to earth faults. Although transient faults do not require immediate repair actions, they are indication of weak points, mainly caused by deficient insulators or insufficient clearance with objects along a power line, which sooner or later could develop into permanent faults. In this respect, transient fault location plays an important part to take pre-emptive actions and to avoid power supply interruptions. Repetition of transient faults in a position can lead to a permanent fault, for example repetitive partial discharge on insulators leads to complete flashover and permanent faults. Therefore, to avoid complete insulation failure, transient faults should be located and defected insulators should be repaired or replaced.

Over the past decade, a suite of methods has been proposed for arcing fault location in transmission lines using measured current and voltage phasors from one end or both ends of the lines [1–8]. In Refs. [1,2] using time area equations and least square method, two schemes have been suggested for detecting arcing fault points in transmission lines. The authors of Refs. [3–6] present different methods based on the current and voltage phasors measured at both ends of transmission lines. It is noteworthy that in these methods for obtaining harmonic component phasors, discrete Fourier transform in full cycle has been used. In Refs. [7,8] only current and voltage phasors measured at one end of the transmission line has been used for arcing fault location.

The basis of the above fault location methods was deterministic computations, which assume system modelling based on conventional mathematical tools (such as differential equations). Arcing faults are

*Correspondence to: Sadegh Jamali, Centre of Excellence in Power Systems Automation and Operation, School of Electrical Engineering, Iran University of Science and Technology, Tehran, Iran.
†E-mails: sjamali@iust.ac.ir; ghaffarzadeh@ee.iust.ac.ir

Copyright © 2011 John Wiley & Sons, Ltd.