Abstract

Continuity of electricity is of utmost importance to all our activities in day-to-day life. This is ensured by having a reliable power system. As faults on EHV lines are quite common, causing disruption in power supply, proper identification and classification and accurate location of faults will assist in faster maintenance and restoration of supply. This work employs wavelet analysis, a relatively new mathematical tool, to develop a method of analysis for electrical transients in electric power systems. Techniques, which are currently employed, fall broadly into two categories - time domain and the integral transform domain. Time domain methods include the mathematical solution of differential equations and companion circuit techniques. The integral transform domain methods include Laplace transform and frequency (e.g., Fourier transform) analysis. Both of the aforementioned categories can be used when solving systems of equations with a wide eigenspectrum or when a system of equations is subjected to a nonstationary forcing function. One of the benefits of wavelet analysis, however, is the ability to easily resolve signals of a nonstationary nature. In this thesis, the main objective is to provide a methodology to identify, classify, locate and analyse power system transients using Wavelet transform technique.

An application of matrix-equation approach in multiresolution analysis (MRA) for calculating the wavelet coefficients as well as for signal decomposition is found suitable not only for characterization of transients in power system but also as an efficient data compression technique.

A new method for identification and classification of faults based on wavelet multiresolution analysis (MRA) is presented. Daubechies eight (D-8) wavelet

transforms of the three Phase currents on transmission lines are used. The peak absolute value, the mean of the peak absolute value and summation of the 3rd level output of MRA detail signals of current in each phase extracted from the original signals are used as the criteria for the analysis. The effects of fault distance, fault inception angle and fault impedance are examined. Two separate approaches are presented for the classification of faults.

A new method is presented for the location of faults based on wavelet multiresolution analysis (MRA) in combination with the methods of cubical interpolation and polynomial fitting. Daubechies eight (D-8) wavelet transforms of the three Phase currents on transmission lines from both the ends are used. The summation of the 3rd level output of MRA detail signals of current in each phase extracted from the original signals are used as the criteria for the analysis. With this criteria, the fault location is determined with a very high accuracy using both cubical interpolation and polynomial fitting. The effects of fault inception angle and fault impedance are examined. The accuracy is as good as more than 99%.

A new scheme is presented to analyse lightning overvoltages on power systems. The application of wavelet multiresolution based analysis (MRA) is proposed here to estimate the peak value, polarity and waveshapes of the lightning overvoltage and also to reconstruct lightning overvoltages striking at any point on a long transmission line. The proposed method uses minimum array of data and is able to analyse lightning overvoltages, which are non-stationary both in time and space. A new technique with a reasonable accuracy of 99% based on the wavelet multiresolution analysis (MRA) for locating the point of strike of a lightning overvoltage on a transmission line is also presented. Daubechies eight (D-8) wavelet transform is used to analyse lightning overvoltages. The 10th level output of MRA detail signals extracted from the original signals is used as the criterion for the analysis.

The general conclusions are arrived at based on the performance and the capabilities of the application of wavelet analysis to power system transients. The multiresolution property in both time and frequency of wavelets facilitates the detection of physically relevant features in transient signals and thus helps in characterizing the source of the transient or the state of the post-disturbance system.