Application of prony analysis for distance protection scheme

Abstract:
The application of prony method for various distance protection schemes is studied in this paper. The prony method extracts the desired information like frequency, amplitude, phase and damping components from a sampled response. The information generated from prony analysis is used for implementing distance protection scheme.

Literature Review:

The early work in application of prony analysis for fault detection and protection was reported in [1]. In this method prony is used to estimate the modal components present in the signal. This methodology is used to analyze earth fault currents in Peterson-coil-protected 20kV networks. Based on differentiating between normal and fault prony's parameters, the type of fault is determined.

Further prony method was extended for power swing blocking functions in [2]. For reliable operation distance should differentiate between power swings and fault conditions. Since distance relays should only act during fault conditions this method detects a symmetrical fault during a power swing based on prony's modal components of current waveform.

This method is extended and applied to detect high impedance faults in [3]. Since transmission lines are suspended from steel towers with earth wires. Very high impedance faults may result in case of arc faults or flash over to trees and depending on the setting of the relay this type of faults may go undetected since high impedance fault are overseen as loads by distance relays. Therefore, detecting high impedance faults is an important issue and can be detected well using prony method.

In [4] proposed a method of filtering techniques for distance relays using prony method. The impact of non-filtered frequency components in the operation of distance relays is studied and finally using prony method is used to filter out inter-harmonics and subharmonics.

In [5] prony method is applied simultaneously to detect high impedance faults and do power swing blocking function. This algorithm simultaneously check for high impedance fault and power swings, if it detect high impedance fault the distance relay will operate and blocks distance relay if power swing is detected.

In [6] the prony analysis for protection is extended to protect doubly fed induction generator (DFIG) based wind farms. This paper identifies the frequency components of currents and voltages during faults and following the feature inconsistency, the adaptability for protection is analyzed. In [7] prony method is applied to transmission lines using RMS values of 3-phase sending and receiving end instantaneous powers.

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