IPASJ International Journal of Electrical Engineering (IIJEE)
A Publisher for Research Motivation........
Web Site: http://www.ipasj.org/IIJEE/IIJEE.htm
Email: editoriijee@ipasj.org
Volume 1, Issue 1, June 2013
ISSN 2321-600X

A framework for Protection schemes for Transmission Circuits

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ABSTRACT

The paper deals with the appliance of wave transforms for the detection, classification and approximate location of faults on Teed Transmission lines. Sampling of 3 section voltage and current signals at the 3 ends of the Teed line are done over a moving window length. This signals ar analyzed with Bior2.2 wave to get detail coefficients of single level decompositions. Fault Indices are calculated supported the add of native and remote finish detail coefficients, and compared with threshold values to notice and classify the faults. The projected formula is tested for various locations.

Keywords: Teed Transmission, Fault Detection, wave Analysis, Fourier Transforms, Short time Fourier transforms, wave transforms.

1. INTRODUCTION

The raised growth of power systems each in size and quality has caused the necessity for quick and reliable relays to shield major instrumentation and to take care of system stability. In the late 1950's solid state relays began to look. These were designed with separate electronic elements like diodes, transistors and operational amplifiers. Static relays are progressively employed in recent years owing to their inherent benefits of compactness, lower burden, less maintenance and high speed. although with success used, the static relays suffer from variety of disadvantages, e.g. inflexibility, inadaptability to dynamical system conditions and quality.

Computer hardware technology has enormously advanced since early 1970's and new generations of computers tend to form computing machine relaying a viable different to the standard relaying schemes. the arrival of microprocessors within the 1970's initiated a revolution within the style and development of digital protection schemes. With the event of economical, powerful and complex microprocessors, there's a growing interest in developing chip –based protecting relays that ar additional versatile owing to being programmable and re superior to traditional magnetism and static relays. The most options, which have inspired the planning and development of chip –based protecting relays, ar their economy, compactness, reliableness, flexibility and improved performance over typical relays.

Chip –based protecting relays offer flexibility and ar superior to traditional magnetism and static relays. The relaying signals, i.e. fault current and voltage contain harmonics and D.C. Offset elements, that need filtering before feeding them to the relay. The chip –based relays, that assume curving waves for the fault voltage and current use analog band –pass filters, that pass 40-70 cycle per second signals. however at low frequency, the analog filters ar slow. analysis is ongoing to develop quicker relays exploitation digital filter techniques. several algorithms for digital distance relaying are derived throughout the past twenty years. These algorithms ar supported resolution of differential equations, separate Fourier transforms and wave transforms.

2. INTRODUCTION TO TEED CIRCUITS

2.1 The necessity for Multi-Terminal Lines

The affiliation of multiple sources to a line is also fascinating for many reasons. raised interconnection between sources inside the system offers raised voltage support and might provide economic benefits over line in line out

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configurations. to boot, the raised offer methods offer larger operational flexibility to the system. so as to satisfy the growing demand of networks, system planners ar baby-faced with the matter of a way to get the generated power to the client. while putting in additional transmission lines or transmission at higher voltages could change the availability of consumers from typical, massive generation facilities, it creates social and environmental issues. Communities ar usually sad with the installation of recent or larger high voltages transmission lines, contention the lines, towers and associated right of means ar environmentally damaging, esthetically unappealing and supply doable health risks. By their nature renewable generation sources got to be placed wherever they'll harness the relevant; wind, solar, hydro energy supply and have a tendency to be smaller than convention fossil fuelled power stations. As these smaller generation units ar added to the network the interconnection between sources will increase.

2.2 Teed circuits

Three terminal lines, or Teed circuits, usually provide right smart economic, technical and environmental advantage over 2-terminal lines. However, it's documented that, for variety of reasons such lines ar usually significantly tougher to shield than plain feeders exploitation typical unit or non-unit protection techniques. Systems 1, a pair of {and 3|and 3} represent the three external equivalents and LI, 52 and fifty-three ar the 3 line sections of the three-terminal line shown in Fig.2.1.

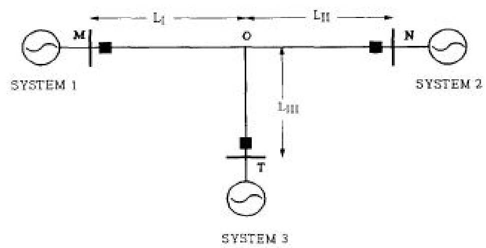

Figure 2.1 Three-terminal lines with the external systems

2.3 Issues in Protection of Teed Circuits

The application of distance relays to the protection of 3 terminal lines is additional advanced than the appliance to 2 terminal lines attributable to the infinite style of faucet locations, line impedances, supply impedances, system loading needs, and system in operation conditions.

The ohmic resistance seen by a distance relay isn't invariably the particular line ohmic resistance from a relay terminal to the purpose of fault. this is often as a result of the relay measures ohmic resistance supported the dip between its location and also the fault and also the line current at its location. Thus, the ohmic resistance seen by the relay can depend on this contributions from the opposite terminals. take into account the system shown in Figure2.2. attributable to the infeed current at terminal B, the gap relay at terminal A can see a plain ohmic resistance of three ohms, that is larger than the particular ohmic resistance to the fault.

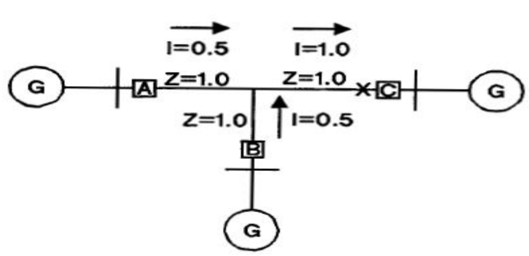

Fig 2.2 Current Infeed

The system shown in Figure a pair of.3 has AN out feed current at terminal B instead of AN in feed current. during this case, the apparent ohmic resistance seen by the relay at terminal A for a fault at terminal C is one.5 ohms, that is a smaller amount than the particular ohmic resistance to the fault. an extra downside is additionally introduced by this out feed at terminal B; since this flows out of the road at B, a forward trying distance relay won't see this internal fault, in fact, if there's a interference unit at B, it should see the inner fault as AN external fault and so stop tripping.

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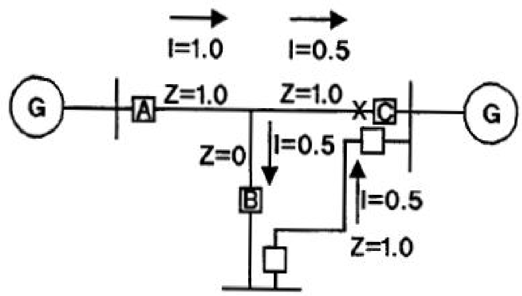


Fig2.3 Current Out feed

With the higher than mentioned issues, we will not apply the standard distance protection technique to the Teed circuits or multi terminal lines. So, during this thesis we tend to ar going for digital protection formula by exploitation this signals and for process those signals wave transforms ar used.

3. WAVE ANALYSIS

Mathematical transformations ar applied to signals to get additional data from those signals that's hidden and isn't promptly out there in their raw format. Transforms wide employed in signal analysis are:

1. Fourier transforms
2. Short time Fourier transforms
3. wave transforms

Each Fourier and short time Fourier transforms have their own drawbacks relating to the frequency and time resolutions, that ar overcome by wave analysis. In recent years, wave rework has emerged as a strong signal analysis tool, and is being employed with success in several areas as well as compression, medicine applications, speech process, acoustics and numerical analysis.

Would like for wave Analysis

Analysis is that the analysis, that breaks down a sign into constituent sinusoids of various frequencies and infinite period. in a different way to consider analysis is as a mathematical technique for reworking our read of the signal from time-based to frequency-based.

For many signals, analysis is extraordinarily helpful as a result of the signal's frequency content is of nice importance.

FT provides the frequency data of the signal, which implies that it tells USA what proportion of every frequency exists within the signal, however it doesn't tell USA once in time these frequency elements exist. which means in reworking to the frequency domain, time data is lost. once viewing a Fourier rework of a sign, it's not possible to inform once a specific event befell. this is often the intense downside of analysis. linear unit may be used for non-stationary signals, if it's solely curious about what spectral elements exist within the signal, however not interested wherever these occur. However, if this data is required, i.e. if we wish to grasp, what spectral elements occur at what time (interval), then Fourier rework isn't the correct rework to use.

Short-Time analysis

There is solely a minor distinction between STFT and linear unit. In STFT, the signal is split into sufficiently small segments, wherever these segments (portions) of the signal may be assumed to be stationary. For this purpose, a window operate "w" is chosen. The dimension of this window should be adequate the section of the signal wherever its stationary is valid.

The STFT represents a form of compromise between the time- and frequency-based views of a sign. It provides some data concerning each once and at what frequencies a sign event happens. However, we will solely acquire this data with restricted exactitude, which exactitude is set by the scale of the window. whereas the STFT compromise between time and frequency data may be helpful, the disadvantage is that after you select a specific size for the time window, that window is that the same for all frequencies. several signals need a additional versatile approach -- one wherever we will vary the window size to see additional accurately either time or frequency.

Wave Analysis

Fourier analysis consists of breaking apart a sign into trigonometric function waves of assorted frequencies. Similarly, wave analysis is that the breaking apart of a sign into shifted and scaled versions of the first (or mother) wave.

Just viewing footage of wavelets and trigonometric function waves, it may be determined that signals with sharp changes may well be higher analyzed with AN irregular wave than with a sleek sinusoid. wave is denoted by the image Ψ (t).

Fault Detection Technique

The line is modelled as ‘ T ’ form and is portrayed in 3 sections every of 5 pi-sections connected in cascade type voltage supply to TEE junction. The system is simulated exploitation MATLAB.

The data of the AC system thought of for the studies is follows.

Component Parameters

Frequency 60 cycle per second

Source -1 Voltage V1 = 500∟20ok V

Equivalent ohmic resistance Z1 =17.177 +j45.529 Ω

Source -2 Voltage V2 = 500∟0ok V

Equivalent ohmic resistance Z2 =15.31 +j45.925 Ω

Source -3 Voltage V3 = 500∟20ok V

Equivalent ohmic resistance Z3 =17.177 +j45.529 Ω

Transmission Line

(300Km)

(S1 to S2 or S1 to S3) Z1 =4.983 +j 117.83 Ω

Y1 = j1.468 x 10-3 Ω-1

Zo = 12.682 +j 364.196 Ω

Yo = j1.099 x 10-3 Ω-1

Power Flow S = 433.63 (MW) +j 294.52(MVAR)

Detection and Classification of Faults

The single level decomposition of 3 section currents of the native terminal is obtained with Bior.2.2 mother wave. The transmitter transmits the detail coefficients (D1L) obtained over a moving window to the remote station although the communication channels. The receiver receives the detail coefficients from native terminal transmitter and remote finish transmitter. At every terminal the remote station d1-coefficients (D1R) ar added to the native detail coefficients (D1L) to get effective D1 coefficients (D1E). The Fault Index (If1) of every section current is then calculated as summation of effective d1-coefficients (over a window length) given by the equation

The fault indices of 3 section currents within the event of fault are conferred. It may be determined that the fault index of faulted phases is incredibly massive compared thereto of alternative healthy phases. thence the faulty section will simply be known. this is often done by comparison the fault index If1with a preset threshold Th1. so the quantity of faulty sections may be determined by comparison fault index If1 of every phase current with the edge worth Th1. exploitation fault index If1 and threshold Th1 faulty phases A and B ar detected within the event of AB fault. within the event of ABG fault the faulty phases ar detected exploitation fault index If1 and threshold Th1. For {a 3|a 3} section fault all the three phases have a fault index If1 more than threshold worth Th1. thence the classification of faults can even be done supported the determination of range of faulty phases.

However double line to ground (LLG) faults can not be distinguished from line to line (LL) faults simply by knowing the quantity of faulty phases. To discriminate the LLG faults from LL faults, another fault index known as ground fault index If2 is calculated, with the assistance of all 3 section current indexes that is given by equation.

If2 = 1/3 □If1 -------------------- (4.2)

This fault index If2 is nothing however fault index of the zero sequence current. If double line fault involves ground the transients would seem in neutral current or the zero sequence and thence the fault index If2 can have massive worth. If ground isn't concerned in double line fault {there can|there'll} not be any path for zero sequence current and thence the fault index will have terribly low worth. this idea is created use to discriminate the LL faults from LLG faults. thence the fault index If2 is compared with a preset threshold Th2 to discriminate LL faults from LLG faults. If If2 is larger than Th2 the fault is assessed as LLG fault otherwise the fault is LL fault.

Approximate Location of Faults

Subsequent to detection and classification of fault, approximate estimation of fault location is distributed. For this purpose the obtained native terminal single level detail coefficients, over a 0.5 cycle window ar used. the utmost and minimum values of the D1 coefficients ar obtained. The ratios of the utmost to the minimum worth of D1 coefficients ar calculated. By perceptive those quantitative relation values we will estimate approximate location of fault whether or not it's before TEE junction or once the TEE junction.

4. SIMULATION RESULTS

Modelling of line

A typical five hundred potential unit gear mechanism employed in the simulation studies conferred herein. It consists of 3 line sections of one hundred fifty klick every, fed from 500KV sources from 3 ends. The nominal power frequency is 60Hz. the only line diagram of the thought of power grid is already shown in section (4.1). The line is modelled as 5 "Π" sections, every of 30Km length from every supply to "TEE" purpose, connected in bicycle. The system is simulated for various fault conditions exploitation Mat workplace code package.

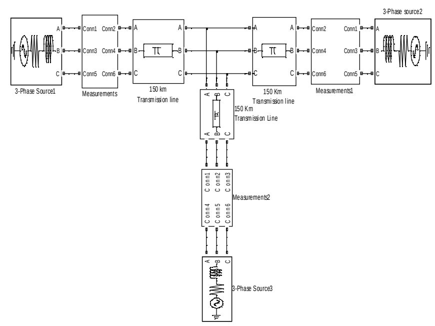
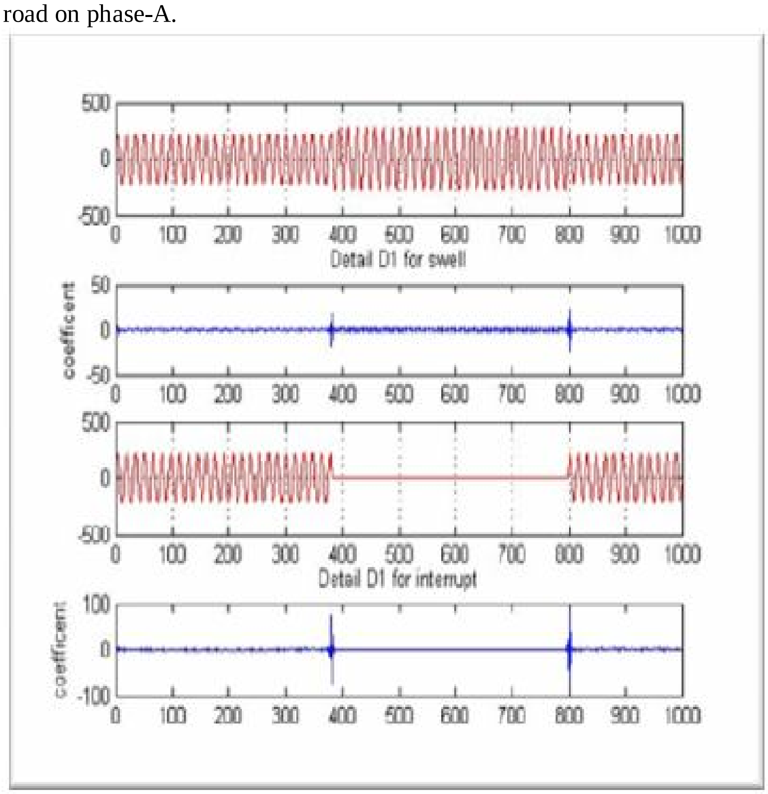
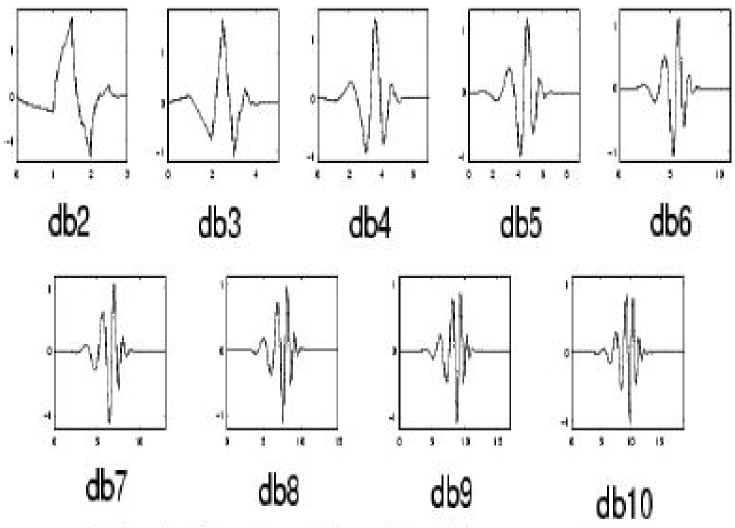


Fig 4.1: line Model

Detection of Fault

Figures illustrates the variations in 3 section currents of 3 terminals within the event of ground fault on phase-A at four-hundredth of the road on phase-A.





The Fault Index (If1) of every section current is then calculated as summation of effective d1-coefficients (over a window length) given by the equation (4.1). so the fault indices of 3 section current signals ar obtained. The fault indices of 3 section currents within the event of ground fault ar conferred in Figure (5.9). It may be determined that the fault index of phase-A is incredibly massive compared thereto of alternative phases. thence the faulty section will simply be known. this is often done by comparison the fault index If1with a preset threshold Th1. so the quantity of faulty sections may be determined by comparison fault index If1 of every phase current with the edge worth Th1.

5. CONCLUSION

In this thesis, a TEED conductor fed from the 3 sources is simulated in Matlab surroundings. wave remodel based mostly Multi Resolution Analysis approach is with success applied for effective detection and classification and approximate location of faults in TEED transmission lines.

In this thesis, a TEED conductor fed from the 3 sources is simulated in Matlab surroundings. wave remodel based mostly Multi Resolution Analysis approach is with success applied for effective detection and classification and approximate location of faults in TEED transmission lines. Approximate fault location is calculable victimization the D1 coefficients magnitudes of currents at the 3 ends. The ratios of absolute values of most and minimum D1 coefficients at totally different locations of the conductor area unit calculated. By the higher than obtained values we will estimate the approximate fault location i.e. whether or not the fault is before Tee purpose or aloof from the Tee purpose.

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