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HARMONIC ANALYSIS OF SIX BUS SYSTEM

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Abstract:

Harmonic load flow analysis has become an important tool of power system analysis and design. Nonlinear loads are continuously increasing. Harmonics have become an important power quality problem because of the increased distortion levels in the power system as a result of an increasing number of Harmonic producing loads. The purpose of harmonic analysis is to ascerta in the distribution of harmonic voltages and harmonic distortion indices in a power system. To find out voltage THD levels in radial. The main effects of harmonics in power systems are heating, overloading, a ging of equipment, increased losses and system unbalancing. Harmonics may lead to malfunctioning of power system components and electronic devices. In an electric power system,the harmonics means that current and voltage are been cockeyed and drifted from the sinusoidal wave. These are generated by then onlinearloads such as rectifiers, discharge lighting, variable speed drivers, transistors etc. A load is said to be non-linear when the supply voltage does not match with the current it draws, Where as the voltage harmonics are mostly caused due to current harmonics. we used Mi Power software. It is a power systems analysis and computer aided software.

Keywords::**Harmonic Analysis, Non linear Loads.**

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INTRODUCTION

A . Introduction

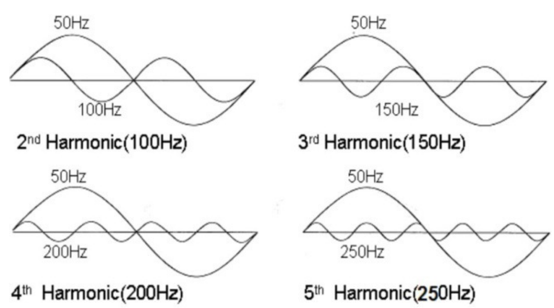
Harmonics and distortion in power system current and voltage waveforms have been present for decades. However, today the number of harmonic producing devices is increasing rapidly. These loads use diodes, silicon controlled rectifiers (scr), power transistors, etc. Due to their tremendousadvantages in efficiency and controllability, power electronic loads are expected to become significant in the future, and can be found at all power levels, from low-voltage appliances to high voltage converters. One result of this is a significant increase in the level of harmonics and distortion in power system networks. The advantages of the power electronic loads are more visible than theharmonics produced by them. Therefore we are using these power electronics devices at all power levels and searching for some other methods for reducing these harmonics created by them.

To introduce harmonic reduction techniques in the system first we have to know how much of harmonics are present. To know the harmonics in the system some methods are available, from the available methods the wavelet transform technique is one of the most popular method in analyzing the harmonics in the given system. This thesis explains how the wavelet transform technique is used for analyzing the harmonics. And with the same method the power is measured in the system, thereby we can reduce the costly meters for measuring power in the system.

Definitionofharmonic

The first step toward understanding how to deal with the problems caused by the interaction of harmonics with power systems or power systems equipment was to settle on a definition of harmonics and a useful means of evaluating them. Over the past few decades this has been done.

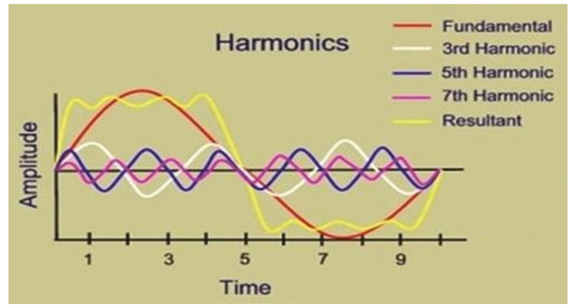
A harmonic is defined as a sinusoidal component of a periodic wave or quantity having a frequency that is an integral multiple of the fundamental frequency. Note that, for example, a component of frequency twice that of the fundamental frequency is called the second Harmonic.



Thus, on a 60 Hz power system, a harmonic component, h, is a sinusoid having a frequency expressed by the following: h n 60Hz Where n is an integer.

CHARACTERISTICS

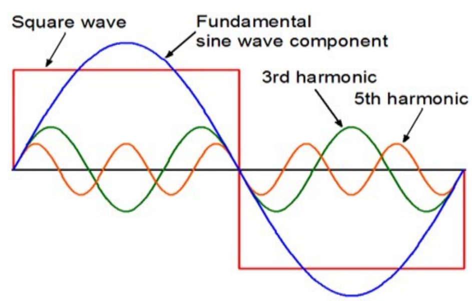
Anyperiodicwaveshapecanbebrokenintooranalyzedasa fundamentalwaveandasetofharmonics.



Thisseparationoranalysisforthepurposeof studyingthewaveshapeseffectonthepowersystemiscalledharmonic analysis. A Harmonic wave can be described completely by the terms: Amplitude and Time.

HARMONIC ANALYSIS

Illustrates one period of a distorted wave that has been resolved into its fundamental and two in-phase harmonic components (the third and fifth). The decomposition of a periodic wave in this manner is referred to as Fourier analysis, after the French mathematician Jean-Baptiste Fourier (1768-1830).



The presence of harmonics in the system is measured in terms of harmonic content, which is defined as the ratio of the amplitude of each harmonic to the amplitude of the fundamental component of the supply system voltage or current. Harmonic distortion levels are described by the complete harmonic spectrum with magnitude and phase angle of each individual harmonic component. The most commonly used measure of the effective value of harmonic distortion is total harmonic distortion (THD) or distortion. factor. This factor is used to quantify the levels of the current flowing in the distribution system or the voltage level at the PCC where the utility supplies their customers. THD can be calculated for either voltage or current and can be defined as

Where, Mi is the RMS value of the fundamental component and M2 to Me are the RMS values of the harmonic components of the quantity M.

Another important distortion index is the individual harmonic distortion factor (DIF) for a certain harmonic h. HF is defined as the ratio of the RMS harmonic to the fundamental RMS value of the Waveform.

$$HF = {M_h}/{M_1} \times 100\%$$

HARMONIC DISTRIBUTIONINDISTRIBUTIONSYSTEM

In electric distribution systems, the magnitude of the harmonic current component is often inversely proportional to its harmonic order, Ih peak is directly proportional to 1/h, and fh is directly proportional to h.
where ih peak is the peak value of the magnitude of the harmonic current, h is the harmonic order and f, is the harmonic frequency

HARMONIC ANALYSIS

The wavelet transform is a powerful computing and mathematical tools which have been used impendent in the fields of applied mathematics, signal processing and others. In wavelet analysis, the use of a fully scalable modulated window can solve the signal cutting problem. The main idea of this method is looks at the signal at different "scale" or "resolution". The result is concluded all of signal for every position, and the spectrum is calculated. In the end of result will collect of time-frequency representations of signal in all of resolution.

For Vs(t) L2 (R), then wavelet transform (WT) of signal s(t) is defined as WT, (a, b) = s(t),b
Where

Yab(t)=((t-b)/a)/√a

is a scaled and shifted version of the mother wavelet w(t). When Pa(t) is defined on open (a, b) half plane where bER a>0. The parameter a corresponds to scale and corresponds to frequency domain property of up(t), parameter b corresponds to time domain property of up(t). In addition, 1/√ a is the normalization value of was(t) for having spectrum power as same as mother wavelet in every scale. Discrete wavelet transform (DWT) is introduced by considering sub- band decomposition using the digital filter equivalent of the DWT.

HARMONIC SYMPTOMS

- Equipmentfailureandmisoperation

The following symptoms are examples of equipment failure and Misoperationassociated with harmonicsonapowersystem:

Overheating (motors, cables, transformers, neutrals) Motor vibrations Audible noise in transformers and rotating machines Nuisance circuit breaker open Electrical fire Voltage notching Erratic electronic equipment operation Computer and/or PLC lockups Voltage regulator malfunctioning Timing or digital clock errors.

- Generator Regulator Malfunctioning
- LED Lights Flickering

- Economic Considerations

Thefollowingareeconomicconsiderationsthatshould beevaluatedwithregardtoharmonics:

- Losses/inefficiency
- KW Losses in cables and transformers
- Low total power factor
- Generator Sizing
- UPS
- Capacityconcerns(transformerc able)
- Utility imposed penalties

- Powerfactorcorrectioncapacitors

Applyingpowerfactorcorrectioncapacitorsrequiresspecialconsiderationswithregardtoharmonics:

- Capacitor filters
- Fuse or breaker(feeding capacitors) nuiance tripping

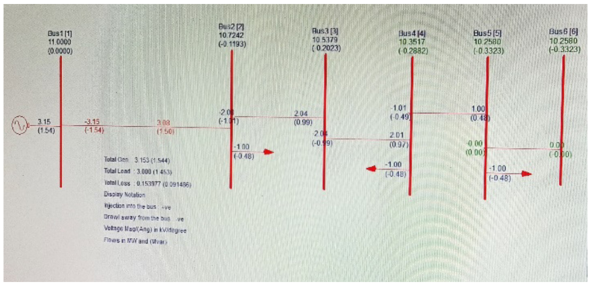


Fig 1. Single line diagram of 6-bus system

Bus voltages, transformer and line loadings are tabulated. Contingency ranking analysis is executed. Record PIF and PIV from the report. Same procedure is followed for each transmission line where only single line is considered for one contingency analysis.

SOFTWAREUSED

A. Introduction ToMiPower:

MiPower software is an Indian based software and was developed by Dr.Nagrath a power systems engineer. It is a power systems analysis and computer aided software. Graphical User Interface (GUI) and database are the two essential components which are needed for the legitimate execution of network and to design any network. We will link the database with the graphical userinterface and this generates a path so that we can enroll values to the components. The main advantage of this software is that the number of buses designed can be unlimited and it takes environmental conditions into the picture. It is user-friendlyand highly interactive. This software is used for different purpose of simulation like load flow analysis, harmonic analysis, short circuitanalysis, voltage instability, fault occur in a line, bus and type of fault, and economic load dispatch.

MiPower is a highly interactive, user-friendly windows based Power System Analysis package. It includes a set of modules for performing a wide range of power system design and analysis study.

MiPower features include a top notch Windows GUI with centralized database. Steady state, transient and electro-magnetic transient analysis can be performed with utmost accuracy and tolerance. Designed to assess the risk of Voltage instability and margin of stability during sudden disturbances, under steady state conditions. It ranks the load busses based on the L-index value and the highest L-index indicates the system collapse point. The value of L-index is zero at no load and 1 at the verge of collapsing point. Performs three-phase harmonic load flow to compute harmonic distortion factors. Calculates harmonic transfer and driving point impedances for both transmission and distribution power systems.

MiPower can be used for various applications such as load flow analysis, short circuit analysis, optimal power flow, transient stability, harmonic analysis, relay coordination, contingency analysis, etc. MiPower has been used by many researchers and engineers for various power system studies and projects. For example, one paper used MiPower to analyze the load flow of existing EHV networks and validated the simulation results analytically.

The lower the VSI value, the more severe the contingency. MiPower has a user-friendly graphical interface that allows the user to create and edit power system models, perform load flow and contingency analysis, view and export results, and customize various settings and options. MiPower also has a database manager, a graph utility, a COMTRADE viewer, an AutoCAD interface, and other features that enhance its functionality.

MiPower can be used for various applications such as load flow analysis, short circuit analysis, optimal power flow, transient stability, harmonic analysis, relay coordination, etc. MiPower is a software tool for power system analysis and simulation. It can perform various studies such as load flow, short circuit, contingency analysis, optimal power flow, harmonic analysis, etc. It can also generate reports and documentation for the results of the studies. MiPower has a graphical user interface that allows the user to create and edit power system models, run simulations, and view the results in different formats. One of the applications of MiPower is to perform contingency analysis and ranking on radial distribution systems.

MIpower Modules

OnOk,theMiPowermainscreenappears.Inordertoactivatethesemodules, selecttheiconbesidethemodulenameanddoubleclick.Allthe modulesareexplainedindetailintheforthcomingchapters.

MiPowerconsistsof the following modules:

- PowerSystemNetworkEditortodrawSingleLineDiagramsandgeneraldiagramsandtoexecutepowersystemstudymodules.
- DatabaseManagertocreateandmodifyMiPowerdata base andto execute power systemstudy modules.
- Batch Mode Interface to convert formatted ASCII files to MiPower data base and vice versa.
- Graph Utility to view study results generated by MiPower ingraphical format.
- Line & Cable Parameter Calculation program.
- Long Term Load Forecast module
- Ground Grid Design
- Automatic Single line diagram generation
- AutoCAD interface
- Application
- Free Programmable Blocks
- DC Network Solutions
- Battery Sizing
- COMTRADE Viewer

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