Matlab Simulation For Fault Analysis of Electrical Circuit on Hyperspectral Signal Processing

T. Arumuga Maria Devi, D. Muthukumar, Saji K.S.

Abstract: The power system contains generation, transmission and Distribution. Abnormal conditions which cause flow of huge current in the conductors through improper paths in the circuit can be defined as a fault. The fault created transient parts which contain inexhaustible flaw data and are resistant to the framework's anomaly have been broadly utilized in the fault examination. The simulation findings demonstrate the system voltage and load currents effects of faults. In this paper, the different voltage circuit information levels will be evaluated using Hyperspectral processing and it is used to determine the exact difference in voltage magnification and evaluate it through signal processing.

Keywords: RLC Resonant circuit, Matlab Simulink implementation, Electrical Quality Analysis, Resistance, Measurement, Power systems, Fault Analysis.

I. INTRODUCTION

Power transmission is a foremost issue in electrical engineering after power generation. Fault in transmission line is common and main problem to deal with in this stream. The errors that occur in energy systems can be categorized as symmetrical and unsymmetrical errors. Increases in current and decreases in voltage and frequency in the failed stage characterize them. The different kinds of faults are single line and double line to ground fault[15]. The study of these faults are necessary to ensure that reliability and stability of the power system. Then paper approaches Matlab Application in which user friendly tool box will assist using that transmission line model design and various fault time will be given with the facilitate of signal builder[22].

After that various effects on bus system due to different are shown such as voltage, current and fault current output in terms of waveforms. By analyzing waveforms we can calculate which fault occurring is maximum[17]. A RLC circuit is contains a series or parallel linked resistor, inductor, and capacitor[23]. The circuit forms a harmonic present oscillator and resonates like an LC circuit. It enables to decay these oscillations by introducing the resistor (R).The resistor also decreases the frequency of the maximum resonant. In real circuits, a number of resistors are needed. The perfect LC or RLC circuit assumes the connecting conductors’ 0 resistance.

A waveform is the shape of a curve that is acquired by plotting the immediate voltage or present values as ordered as abscissa against time. Figure 1.1.(a), 1.1.(b),1.1.(c) and 1.1.(d) indicates uneven waveforms, but each present or voltage cycle represents an exact replica of the prior one. Usually both positive and negative half waves have alternating electromotive force and currents generated by machines, the same shape as shown in Figure 1.1.(f) represents a sine wave of Alternate Current.

Figure 1.1.(a) Complex Wave

Figure 1.1.(b) Triangular Complex Wave

Revised Manuscript Received on July 22, 2019.

* D.Muthukumar

Dr.T.Arumuga Maria Devi*, Assistant Professor, CITE, Manonmaniam Sundaranar University, Tirunelveli, Tamilnadu, India. Email: deviececit@gmail.com.

D.Muthukumar, Research Scholar, CITE, Manonmaniam Sundaranar University, Tirunelveli, Tamilnadu, India. Email: dmkumarvn@gmail.com.

Saji K.S., Research Scholar, CITE, Manonmaniam Sundaranar University, Tirunelveli, Tamilnadu, India. Email: sajiks123@gmail.com.
The maximum value of an alternating quantity, whether positive or negative, is amplitude. The number of cycles is alternating volume frequency. Hertz (Hz) is its unit. The time taken to finish the cycle by an alternating amount is called the time period. A 50Hz AC current, for instance, has a 1/50 second time span.

**Hyperspectral data analysis:**

Hyperspectral data cube provides sufficient spectral information for more precise and comprehensive information extraction to recognize and differentiate spectrally comparable circuit data. Based on spectral data and spatial data, wide variety of sophisticated classification techniques is accessible[24].

To enhance classification precision, uncertainties in the image processing[10] chain must be identified and reduced[7]. Because of band continuity and limited sampling bandwidth, multiple mathematical techniques can be applied.

Hyperspectral information processing's main difficulties include reducing noise, recovering subtle absorption characteristics, analyzing spectral matching, classifying and creating library spectrum that can guide spectral classification.

Figure 1.2 demonstrates a Hyperspectral Data Cube spatial and spectral data.

**II. CIRCUIT ANALYSIS**

Matlab Simulink is a dynamic systems modeling, simulation and analysis software package[14]. Simulink is integrated with MATLAB, which is used to model, simulate and analyze systems and also provides support for linear and nonlinear systems based on continuous time [1]. Multirate systems can also have distinct components that are sampled or updated in distinct ways, etc[18].

Using click and drag mouse activities. Simulink also involves a extensive block that can customize our own blocks and generate them[16].

The model integrates a sine wave with the sine wave and displays the outcome. The model's block diagram appears as Figure 2.1.
A) Sim Power System

Simscape offers component libraries for electrical power systems modeling and simulation. These parts can be used to assess analog circuit architectures, create electrical drive schemes, and analyze grid-level electrical power generation, distribution, and consumption[21]. Sim Power System supports the development of control structures and performance testing at system level. Using Matlab variables and phrases, design control schemes for electrical systems in Simulink, we can parameterize our models.

B) Measuring Voltage and Current

The SimPower Systems Software package is a Matlab program element that enables you to analyze an electrical circuit by drawing it in an editing window[2]. The SimPower Systems model is shown in Figure 2.2 and enables the circuit present and voltage signal to be visualized and a unitary impulse[6]. The circuit's electrical parameters have the following values:

$$R = 50[\Omega]; L = 1[H]$$

C) Filtering Data using Signal Processing Toolbox

All filter design features work with standardized frequencies, so the system sampling rate is not required as an additional input argument[25].

This toolbox utilizes the convention defining unit frequency as half the frequency of sampling. Therefore, the normalized frequency is always in the $0 \leq f \leq 1$ interval. 300 Hz is $300/500=0.6$ for a scheme with a sampling frequency of 1000Hz. To convert the normalized frequency around the unit circle to the angular frequency, multiply by $\pi$. Multiply by half the sample frequency to transform normalized frequency back to hertz. Figure 2.4 displays signal visualization in the Filter Design Tool.

Figure 2.1 Block diagram of the Simulink model

Figure 2.2 SimPower Systems model of an inductive circuit

Figure 2.3 The analysis window of the circuit

Figure 2.4 Filter Design to visualize the signal

Note that the frequency response was calculated throughout the standardized frequency range $[-1 + 1]$ by passing the 'whole' option to 'freqz'. The reply was wrapped just as FFT data is using fftshift to plot the negative frequency information in a natural manner. Figure 2.5 shows Normalized frequency range with Magnitude Response.
D) Medical Diagnosis

Bio-Electrical Engineering is a discipline involved with the growth and manufacture of prostheses, medical devices, diagnostic devices, medicines and so on, all of which require bioelectrical signals [3]. Typically these bioelectric signals are very low in amplitude and require amplification in order to correctly record, display and evaluate the signals. Measurement Techniques are [8]:

- Disturbance should be filtered out.
- The amount of data should be reduced by discriminating only the most significant ones related with required information.

To obtain the data needed from the biosignals [4]:

- Head - (Magnetic Resonance Imaging/MRI)
- Body - (Computed Tomography/CT)
- Heart - (Electrocardiogram/ECG)
- Muscles - (Electromyogram/EMG)
- Scalp - (Electroencephalograph/EEG)
- Eyes - (Electrooculogram/EOG)
- Head - (Hyperspectral Imaging/HSI)

Figure 2.1 shows Grayscale representation of Wavelength and Reflectance information of Hyperspectral image slice [5].

### III. CIRCUIT ASSESSMENT IN DIFFERENT VOLTAGE AND CURRENT LEVELS

A linear circuit is one whose parameters don’t change with Voltage/Current. A non-linear system is one whose voltage or current parameters change.

<table>
<thead>
<tr>
<th>Utility Load components</th>
<th>Frequencies (Hertz)</th>
<th>Wavelength (λ=c/f) metre =3.0x10⁸ m/s</th>
<th>Time(Period) T=1/f</th>
</tr>
</thead>
<tbody>
<tr>
<td>Local Commercial Power Supply (220-240V)</td>
<td>50Hz</td>
<td>1.1~6000000</td>
<td>T1=0.02</td>
</tr>
<tr>
<td>Local Commercial Power Supply (100-110V)</td>
<td>60Hz</td>
<td>2.2~5000000</td>
<td>T1=0.0166</td>
</tr>
<tr>
<td>Railways</td>
<td>25Hz</td>
<td>1.1~12000000</td>
<td>T1=0.04</td>
</tr>
<tr>
<td>Single base Distributing System</td>
<td>16.7Hz</td>
<td>1.1~17964071.86</td>
<td>T1=0.0598</td>
</tr>
<tr>
<td>Motor and Transmission needs</td>
<td>40Hz</td>
<td>1.1~7500000</td>
<td>T1=0.025</td>
</tr>
<tr>
<td>Aircraft, Space craft, Server Room, Military equipments</td>
<td>400Hz</td>
<td>1.1~7500000</td>
<td>T1=0.0025</td>
</tr>
</tbody>
</table>

Figure 2.1 Hyperspectral signal visualization of Spectra in the nuclear and interstitial areas.
Figure 3.3. MATLAB-Simulink Circuit Design - RLC Series and Parallel circuits for 230V 50Hz AC input.

We obtain samples in Series and Parallel RLC circuits for 230V 50Hz AC in our study. Use the MATLAB Simulink Scope tool to view the signal information.

IV. FAULTS ON TRANSMISSION LINES – TRANSIENT FAULTS

The task of repair and maintenance can be assisted by rapid information about the type and location of the fault, minimizing the economic effects of power interruption. Transmission and distribution networks of voltage are the cornerstone of contemporary power generation and distribution systems. Transmission system failures can result in serious financial losses[19][20].

An assessment of system disturbances offers a wealth of useful data about the events of the energy scheme and security system behaviour. Helps enhance system reliability and accessibility.

System failures generally result in important modifications in the amounts of the system that can be used to different circumstances.

These include:

- Over current
- Under Voltage or Overvoltage
- Power factor and/or phase angle
- Impedance
- Frequency

Anyway, a sudden and usually substantial rise in current and reduce in phase voltage is the most prevalent fault indicator. Figure 4.1 shows different types of Power fault and their visualization.

V. ALGORITHM

The suggested simulation algorithm is outlined here:

Step-1. AC Voltage/Current source to input the distinct load.

Step-2. Connect the RLC branch of Series to flow in circuit load.

Step-3. Use the Pi Section Line, Digital Clock and Circuit Breaker instrument to assess in-between load flow.

Step-4. To measure the value using Scope instruments to assess the information of the visualization signal.

Step-5. Use the workspace tool to store the data value of the signal in vector array at different frequency levels.

Step-6. Use the Scope viewer tool to view the signal’s amplitude levels based on Time/Frequency range.

Step-7. The same technique applies to analyzing signal information with separate time series for distinct voltage or present load.

VI. EXPERIMENTAL RESULTS AND DISCUSSION

In this paper Matlab Simulation implemented for Fault Analysis of Electrical Circuit on Hyperspectral Signal Processing.

Figure 4.1 Different types of Power fault and their visualization.

Figure 6.1 shows the waveform of 230V, 50Hz compared with 110V, 60Hz.
Matlab Simulation For Fault Analysis of Electrical Circuit on Hyperspectral Signal Processing

Figure 6.1 The waveform of 230V, 50Hz compared 110V, 60Hz.

Figure 6.2 Two phase ground short-circuit current waveform

Figure 6.3 Two phase ground short-circuit voltage waveform

Figure 6.4 Two-Phase short circuit current waveform

Figure 6.5 Two-phase short circuit voltage waveform

Figure 6.2 shows Two phase ground short circuit current waveform. Figure 6.3 shows Two phase ground short-circuit voltage waveform. Figure 6.4 shows Two phase short circuit current waveform and Figure 6.5 shows Two-phase short circuit voltage waveform.

Figure 6.6 Low frequency oscillatory transient

Figure 6.7 Millisecond impulsive transient

Figure 6.8 Instantaneous Sag
wave, and Figure 6.9 shows Instantaneous Swell wave signal to view the different types of Power quality disturbance occurrences[9]. Table 6.1 shows Voltage, Current and Time/Frequency data. Figure 6.10 shows Voltage, Current and Time/Frequency Value Visualized in Hyperspectral 3D Mesh View[12][13].

VII. CONCLUSION

In this paper, an infinite power supply system is used to build a power system simulation model in Matlab, and the short-circuit current of several short-circuit faults is simulated and analyzed. The results are shown that the powerful Matlab simulation system provides an effective experimental research method for power system analysis and greatly simplifies the workload of calculation and analysis. In this paper, the Voltage and Current level analytical study showed that the statistical conduct of a device at differing time series data from the distinct level.

Voltage and current data are tested through Matlab Simulink application and retrieved data are visualized through Hyperspectral data cube. It gives accurate Voltage and Current magnification to monitor power quality. In our future study the same analytical study will be done using Ultra spectral signal Processing.

REFERENCES

1. Dr. Asad Yousuf, Dr. Mohamad A. Mustafa, Mr. William Lehman, “Electric Circuit Analysis in MATLAB and Simulink”, Savannah State University, 121 ASEE Annual Conference & Exposition, June 15-18, 2014 Paper Id. 19278.
Matlab Simulation For Fault Analysis of Electrical Circuit on Hyperspectral Signal Processing


AUTHORS PROFILE

Dr. T. Arumuga Maria Devi Received B.E. Degree in Electronics & Communication Engineering from Manonmanium Sundaranar University, Tirunelveli India in 2003, M.Tech degree in Computer & Information Technology from Manonmaniam Sundaranar University, Tirunelveli, India in Science and Engineering from Manonmaniam Sundaranar University, Tirunelveli, India in 2012 and also the Assistant Professor of CITE of Manonmiam Sundaranar University. Her research interests include Image and Communication, Multimedia and Remote Communication.

Mr. D.Muthukumar Received MSc(IT) Degree from Alagappa University, Karaikudi, India in May 2003, M.Tech(CIT) degree from MS University, Tirunelveli, in April 2009. Currently, he is doing Ph.D in Computer and Information Technology. His research interests include Hyper spectral Image Processing.

Mr. K. S Saji Received M.Tech degree in Computer and Information Technology from Manonmaniam Sundaranar University, Tirunelveli, India. Currently, he is doing PhD in Computer and Information Technology, Manonmanium Sundaranar University, Tirunelveli, Tamilnadu, India. His research interests include Image Processing, Voxel based Morphometry and Machine Learning.