

## Simulation of Transmission Line using MATLAB

**Kunal Patil\*, Rohan Sonawane, Ashutosh Tarle, Prathamesh Walunj,**  
*Department of Electrical Engineering, K. K. Wagh Institute of Engineering Education & Research, Nashik, India*

**\*Corresponding Author**  
**E-Mail Id:** kunalpatil1676@gmail.com

### ABSTRACT

*The demand of electricity increases day by day these results to transmit more power by increasing the transmission line capacity from one place to the other place. The main goal is to develop a MATLAB based Simulation model for analyzing 3- phase symmetrical and unsymmetrical faults on power transmission lines. Generally, these faults occur in the long transmission line system such as single line to ground fault (L-G), double line to ground (2L-G), triple line to ground fault (3LG) and Line to line fault (L-L). Fault analysis for different kinds of faults has been done and its impacts are appeared in simulation results such as current and voltage. This results into the MATLAB software in which transmission line model is simulated. MATLAB can manipulate and invert large matrices and can be used in many several applications. MATLAB is more convenient with a recent addition called Simulink, a program which is normally used in the analysis of modern control systems. Simulink, now incorporated into MATLAB, can also be used to design distributed transmission lines. In addition to demonstrating its wider applicability, many examples are included that are normally described in books or papers directed to the study of faults along transmission lines. As the importance of energy efficiency grows for companies and government regulators, so does the need for theoretical analysis.*

**Keywords:** Simulink, transmission lines, faults, line to line, line to ground

### INTRODUCTION

Transmission line is the long conductor with design to carry bulk amount of generated power at very high voltage from one station to another as per variation of the voltage level. In transmission line detection of voltage drop, transmission efficiency, line loss etc. are important things to design. Voltage drop, transmission efficiency, are affected by line parameter R, L and C of the transmission line. Length wise transmission lines are of three types.[1,2]

When different types of faults occur in power system then in the process of transmission line fault, analysis, and determination of the RMS line current and bus voltage is possible. While referring to

the power system the terms bus voltage and RMS current of line are vital. In case of three phase power system generally two faults occur, three phase unbalance fault and three phase balance faults on transmission line of power system, such as double line to ground fault, line to ground fault and double line fault. The transmission line fault analysis helps to select and better development of protection for system.

For the protection of transmission line, we place the circuit breakers, and its rating mainly depends on triple line fault. The reason behind is that the triple line fault current is very high as compared to other fault current. Hence by using MATLAB simulation in computer, the analysis of

transmission line fault can be easily done. The main purpose is to study the general fault types which are balance and unbalance faults of transmission line in the power system. Also, to perform the analysis and obtain the result of various parameters (voltage, current, power etc.) from simulation on those types of faults.[3-5]

### SCOPE

- MATLAB simulation can be used to minimize human errors and this simulation study helps in verifying theoretical aspects.
- Better understanding of effect of faults on transmission line and helps in acquiring detailed data of respective parameters.

### OBJECTIVE

- To develop a MATLAB based Simulation model for analyzing 3- phase symmetrical and unsymmetrical faults.

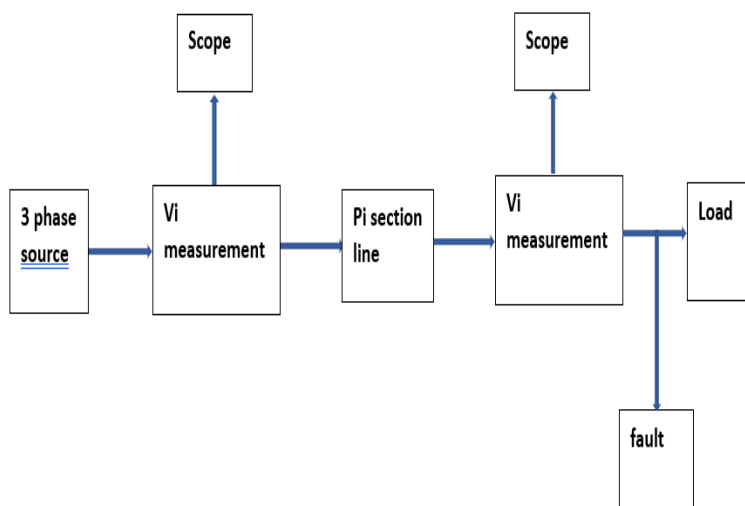
- Use of simulation of transmission line using MATLAB over conventional method.

### METHODOLOGY

Three phase source block is added from MATLAB library with feeding data in the block. Three phase source is working as grid station or generator at the sending end station. Phase to phase RMS voltage block is connected to VI measurement block. Measurement blocks are connected to display so that voltage and current can be measured. Scope has been connected to VI measurement block so that voltage and current waveforms can be observed.

Gainers and adders are introduced on receiving end of transmission line. The PI Section Line block implements transmission line with parameters lumped in PI sections. For a transmission line, the resistance, inductance, and capacitance are uniformly distributed along the line. Three phase RC load has been added to observe the power flow in transmission line.[6]

### SYSTEM OVERVIEW



*Fig. 1: Block diagram of system.*

### Phase Source

An adjusted three-phase source consists of three single stage sources with rise to greatness and  $120^\circ$  stage move between

each source. A conductor in such framework is called the unbiased, which is further associated to the ground references.

**VI Measurement**

The Three-Phase V-I Estimation square is used to degree momentary three-phase voltages and streams in a circuit. When associated according to three-phase components, it returns the three phase-to-ground or phase-to-phase crest voltages and streams.

**Scope**

Scopes gives visual representation for showing recreation information and capturing the information for afterward examination. Images on graph shows different information and capture strategies.

**Pi Section Line**

The PI Segment Line square actualizes an N-phase transmission line with parameters lumped in PI areas. For a transmission line, the resistance, inductance, and capacitance are consistently conveyed along the line.

**Fault**

These are single line to ground fault or SLG fault, line to line fault or twofold line fault signified as LL or DL, two-fold line to ground fault said as LLG or DLG fault and triple line flaws.

**Load**

The consumer end where power is to be maintained constantly reliable.

**STUDY OF FAULTS****L-G Fault**

The line to ground fault (L-G) is the common fault and 65-70 percent of deficiencies are of this type. These are called lopsided issues since their occurrence causes unbalance within the framework. The Unbalance of the framework shows that that impedance values are different in each stage causing unbalance current to stream in stages. These are more difficult to analyze and are carried by per stage premise comparable to

three-phase adjusted issues. This single L – G fault happens once a single conductor falls toward the ground terminal. So approximately 70 to 80 % of the fault inside the control framework is the single L – G fault.

**Effect on voltage**

Voltage on flawed stage diminishes and decreases to zero whereas the voltage in sound stages rises somewhat at the time of event of the fault. The change in voltages of all the stages have moreover been watched amid the defective period. The voltage of defective stage moreover shoots at the time of clearance of fault.

**Effect on current**

It can be watched that the current within the defective stage diminishes to the zero amid fault occasion and current in solid stage remains unaltered. However, the current within the flawed stage increments marginally at the time of clearance of the fault.

**LL Fault**

The line-to-line flaws happens when two conductors contact each other primarily whereas swinging of lines due to winds and 5- 10 percent of the issues are of this sort. This L– L fault basically happens once two conductors are short-circuited conjointly due to overwhelming wind. So, the line conductors can be moved since of overwhelming wind, they may touch with each other, and causes short-circuit. So, 15 – 20% of the flaws can happen around.

**Effect on voltage**

The twofold line fault is reenacted with fault between stages The voltage greatness in both the stages diminishes amid the flawed conditions and take after the same drift. In any case, the voltage of solid stage remains the unaffected amid flawed conditions. At the time of clearance of fault, the voltages within the flawed stages

pick up their unique values after the slight unsettling influences.

#### **Effect on current**

The current within the flawed stages diminishes and current drawn by the stack from the sound stage changes only slightly. The streams within the defective stages are in same stage. At the time of fault clearance, the streams once more reestablish their unique values after taking after the slight deviations.

#### **LLG Fault**

15 to 20 percent of deficiencies are twofold line to ground and causes the two conductors to form contact with the ground. In this kind of fault, both the two lines get in touch with each other through the ground. So, there's a 10% likelihood for flaws. 15 to 20 percent of faults are double line to ground and causes the two conductors to contact the ground. In this kind of fault, both the two lines get in touch with each other through the ground. So, there is a 10% probability for faults.

#### **Effect on voltage**

The voltage within the defective stages diminishes to zero after taking after the slight transient disturbances. The voltage within the healthy phase first increments to a tall esteem and after that accomplishes the first esteem after clearance of fault. Tall recurrence drifters have been watched within the voltages of all the three stages.

#### **Effect on current**

The current within the defective stages diminishes to zero amid the fault period and recaptures their unique values after clearance of the fault. In any case, at the time of fault clearance slight deviations have been watched within the streams of flawed stages. The current within the solid stage holds the waveform as well as unique values.

#### **LLLG Fault**

These are exceptionally serious flaws and happen occasionally within the control frameworks. These are too called adjusted issues. As it where 2-5 percent of framework issues are symmetrical issues. On the off chance that these issues happen, the framework remains adjusted but comes about in serious harm to the electrical control framework gear. The 3-phase L – G fault primarily comprises all the 3- stage of the framework. This fault primarily happens among the 3- stages as well as the ground terminal of the framework. So, there's a 2 to 3% of likelihood to happen the fault.

#### **Effect on voltage**

Sometime recently the fault happens the voltage and current are swaying at typical recurrence. We see the supply voltage within the MV extend, whereas the current is exceptionally moo. When the fault happens, the voltage yield from the framework abruptly drops to V for all stages, whereas the current waveforms become extremely huge. This can be a gigantic current that's able of causing extreme damage and harm to gear. Impact on current: Once the fault occurs, the current provided by the AC framework is occupied into the ground association, instead of being provided downstream into the circuit. The voltage yield from the system suddenly drop to zero as measured over the stack; there's no current coming to the stack within the framework.

#### **LLL Fault**

These sorts of flaws are adjusted which suggests the framework remains adjusted after the fault happens. So, this fault occasionally happens, although it is the severe kind of fault that holds the biggest current. So, this current is utilized to decide the rating of the CB.

#### **Effect on voltage**

The voltage in all the three stages diminishes to zero. At the time of fault

clearance, the voltages increment to a tall esteem and recapture their unique values after a few cycles from the clearance of fault. Since the voltages increment to tall values at the time of fault clearance, this may harm the stack types of gear due to tall voltage.

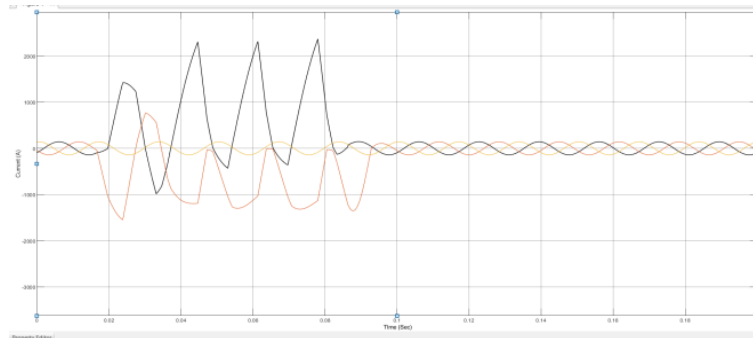
### Effect on current

The current in all the three stages diminishes to zero fair after the fault event and recaptures their unique values after clearance of the flaws. The streams drawn by the stack are moreover tall at the time of fault clearance. Usually due to tall voltage at the time of fault clearance. When LG, LL, LLG, LLL or LLLG fault

happen in a framework at that point current increments and voltage diminishes. Increment in current happen due to the reality that 0system impedance diminishes amid fault condition whereas diminish in voltage happens due to demagnetizing nature of armature response. As we know fault current is nearly slacking in nature considering the reality that fault current is majorly constrained by framework reactance. So, amid fault condition slacking current increases which increment demagnetizing armature MMF which is able result in decrease of resultant field MMF. Due to diminish in net field MMF, excitation voltage diminishes thus terminal voltage moreover diminishes.

## RESULTS

### Current Waveform of LLG Fault

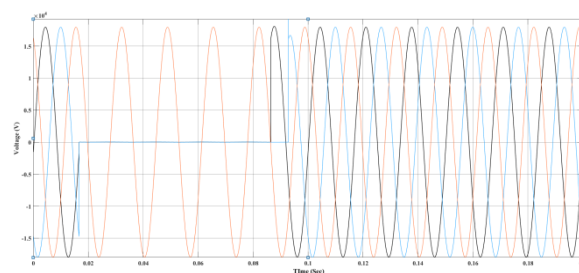


**Fig 1: Effect of fault on receiving end current**

Fig.1 shows effect of LLG fault on voltage with respect to time. Figures depict the current waveform during the occurrence of double line to ground fault. The current waveform was stable until fault occurred. When the fault occurs, however, the

current waveforms of phase A and B appeared swollen, which indicates an unhealthy network. As soon as the fault duration elapsed, the voltage waveforms become stable.

### Voltage Waveform of LLG Fault



**Fig 2 :Effect of fault on receiving end voltage**

Fig 2 shows effect of line-to-line fault on voltage with respect to time. Figures depict the voltage waveform when this fault is occurred. The voltages of the faulted phases do not drop to zero but decreases as there is no ground.

### **FUTURE SCOPE**

Tall request in power utilization is rising and modern society would cease to operate without get to power. The volume of control transmitted and dispersed are expanding, these require the prerequisites for tall quality and solid supply. These necessities are satisfied by examining and understanding the behavior of different types of issues within the control framework. Fault investigation is an imperative thought in control framework arranging, security gear choice, and in general framework unwavering quality appraisal. The fault examination of a control framework is required in arrange to supply data for the choice of switchgear, setting of transfers and steadiness of framework operation. A control framework isn't inactive but changes amid operation (exchanging on or off, of generators and transmission lines) and amid arranging (expansion of generators and transmission lines). In this way fault thinks about ought to be routinely performed by utility engineers. When a fault (e.g., a brief circuit) happens at a few.

### **CONCLUSION**

The work carried out within the report can be summarized as takes after. This report gives depiction of framework beneath thought whereas too giving calculations for diverse parameters related to transmission line. MATLAB recreation demonstrate gives fundamental thought

approximately planning the framework; Charts of current and voltage in ordinary and defective conditions are appeared for the purpose of simple understanding and for appearing impact of fault on them in legitimate way.

### **REFERENCES**

1. Boora, S., Yadav, M., Kumar, N. (2019). MATLAB Simulation Based Study of Various Types of Faults Occurring in the Transmission Lines. *IJERT*, 8(12).
2. Lonngren, K. E., & Bai, E. W. (1996). Simulink simulation of transmission lines. *IEEE Circuits and Devices Magazine*, 12(3), 10-14.
3. Kincic, S., & Papic, M. (2013, July). Impact of Series Compensation on the voltage profile of transmission lines. In *2013 IEEE Power & Energy Society General Meeting* (pp. 1-5). IEEE.
4. Liao, Y., & Elangovan, S. (1998). Digital distance relaying algorithm for first-zone protection for parallel transmission lines. *IEE Proceedings-Generation, Transmission and Distribution*, 145(5), 531-536.
5. Saha, M. M., Rosolowski, E., & Izykowski, J. (2011, October). A fault location algorithm for series compensated transmission lines incorporated in current differential protective relays. In *2011 International Conference on Advanced Power System Automation and Protection* (Vol. 1, pp. 706-711). IEEE.
6. Osman, A. H., & Malik, O. P. (2004). Protection of parallel transmission lines using wavelet transform. *IEEE Transactions on power delivery*, 19(1), 49-55.