Power Systems Laboratory (EE3P006)

EXPERIMENT-3

Shorya Sharma
19EE01017

Aim of the Experiment:

Fault detection and R-X trajectory plot in Transmission Line for differenttypes of faults.

Parameters & Data:

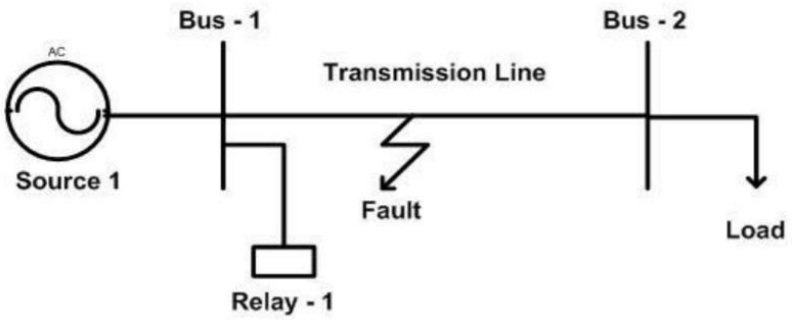


Fig. 1. Single-circuit transmission with source at one end and load at other end

- **Three Phase Source Parameter**

Phase to Phase voltage= 345 KV, Phase angle = 30-degree, Internal Connection Y_g, Short circuit level $1500x10^6$ VA, Base Voltage=400 KV, X/R ratio= 10, Frequency=50 HZ

- **Transmission Line Parameters**

No. of Phases=3, frequency=50HZ
Resistance per unit length [R_1, R_0]= [0.01537, 0.04612]
Inductance per unit length [L_1,L_0]= [$0.8858x10^{-3}$, $2.6547x10^{-3}$]
Capacitance per unitlength [C_1, C_0]= [$13.06x10^{-9}$, $4.3551x10^{-9}$]
Line length of each section = 200 Km

- **Load Data**

Load = 100 MW, 40 MVAR

Apparent Impedance for Different Fault Types:

1) Three phase fault: $Z = \frac{V_A}{I_A}$ or $\frac{V_B}{I_B}$ or $\frac{V_C}{I_C}$

2) Line to Line and Double Line to ground fault: $Z = \frac{V_A - V_B}{I_A - I_B}$ (for AB or AB-to-ground fault)

$\frac{V_B - V_C}{I_B - I_C}$ (For BC or BC-to-ground fault)

$\frac{V_C - V_A}{I_C - I_A}$ (For CA or CA-to-ground fault)

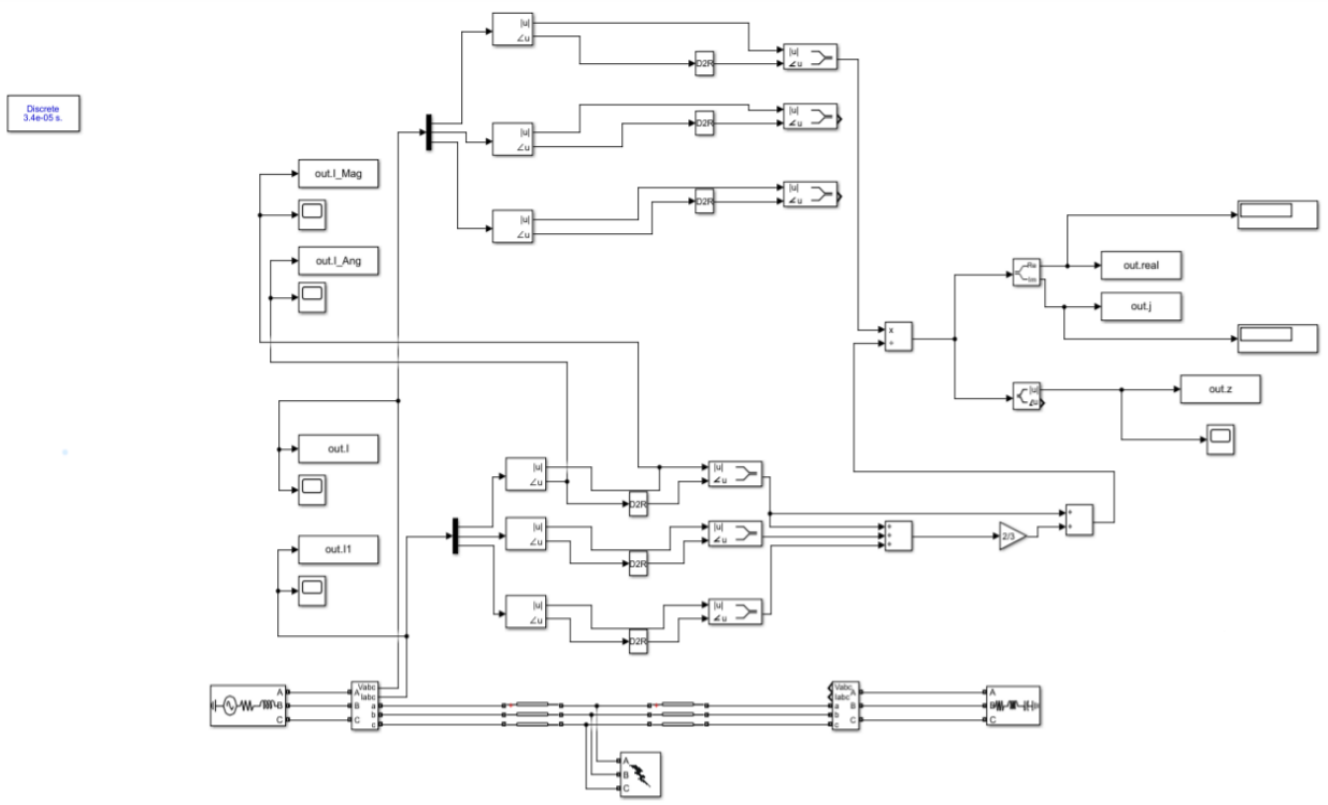
3) Line to ground fault: $Z = \frac{V_A}{I_A + kI_0}$ (For A phase-to-ground fault),

$\frac{V_B}{I_B + kI_0}$ (For B phase-to-groundfault),

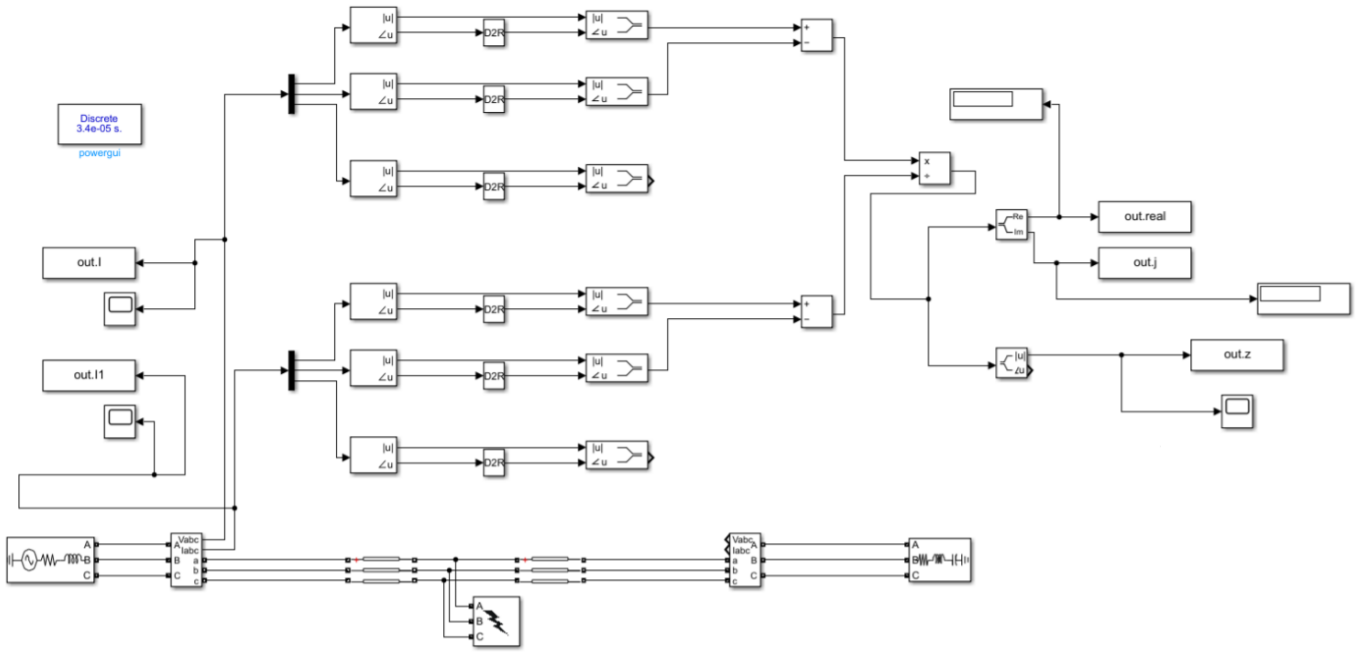
$\frac{V_C}{I_C + kI_0}$ (For C phase-to-ground fault) , where $k = \frac{Z_0 - Z_1}{Z_1}$

CIRCUIT DIAGRAM

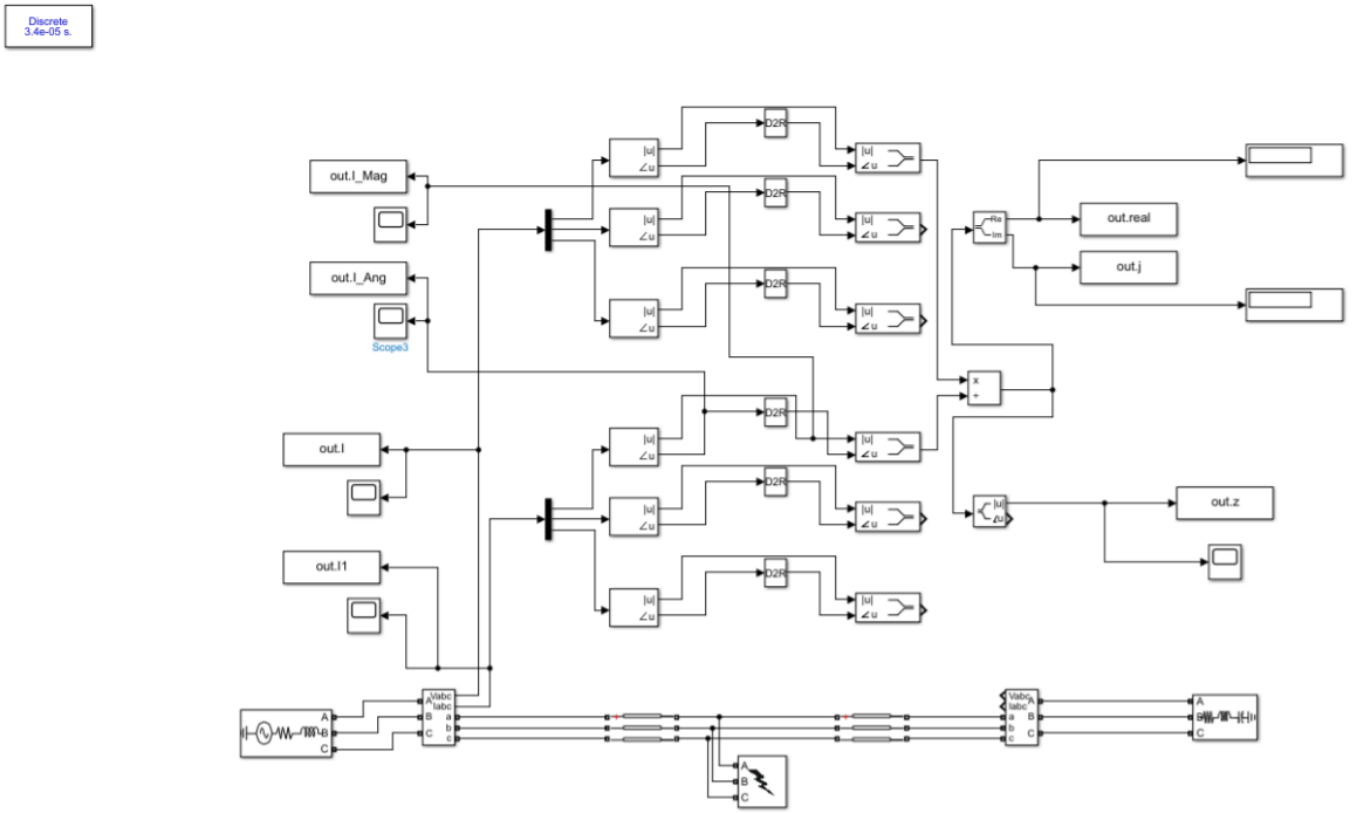
1. L-G



2. L-L & L-L-G


Discrete
3.4e-05 s.
powergui
out.I
out.I1
out.real
out.j
out.z
D2R

3. L-L-L


Discrete
3.4e-05 s.
out.I_Mag
out.I_Ang
Scope3
out.I
out.I1
out.real
out.j
out.z
D2R

Test Cases

- **Case-I:**

1. Create a single line to ground(A-G) fault at 50 Km from source- 1 with fault resistance of 0.1 Ohm at 0.7s

(a) Plot the instantaneous current wave form

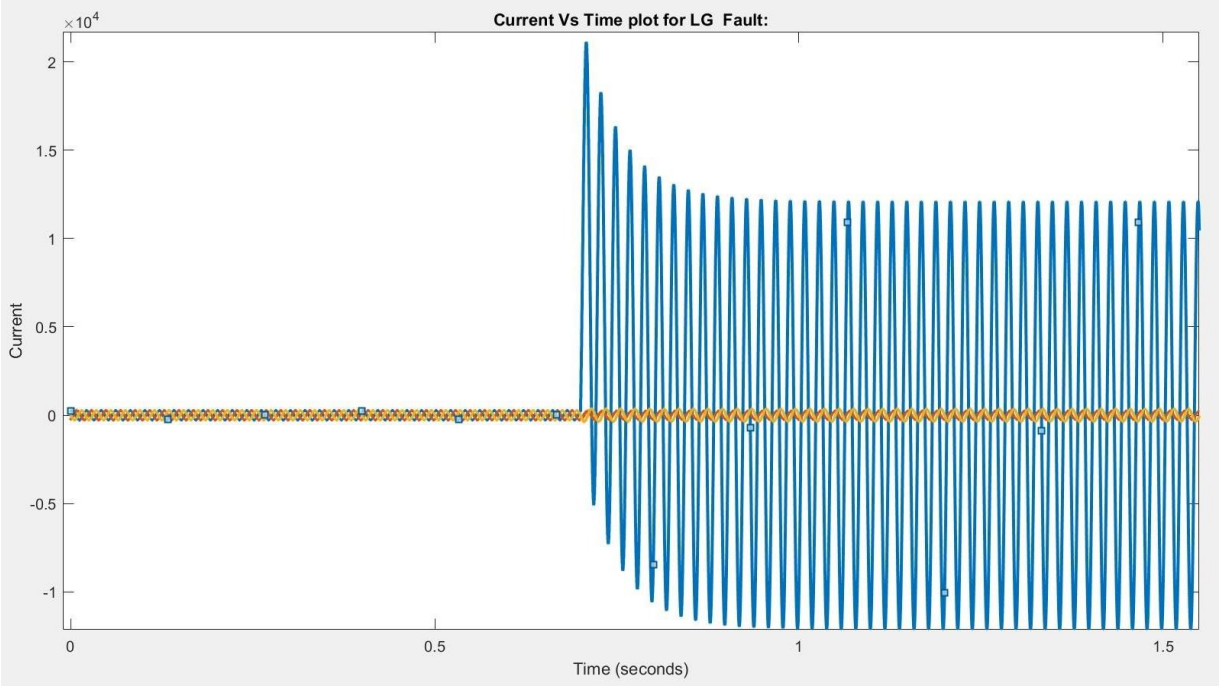


Fig-1: Plot the instantaneous current wave form of all the phases at bus B- 1with single line to ground(A-G) fault at 50 Km from source- 1 with fault resistance of 0.1 Ohm at 0.7

(b) Plot the instantaneous voltage waveform

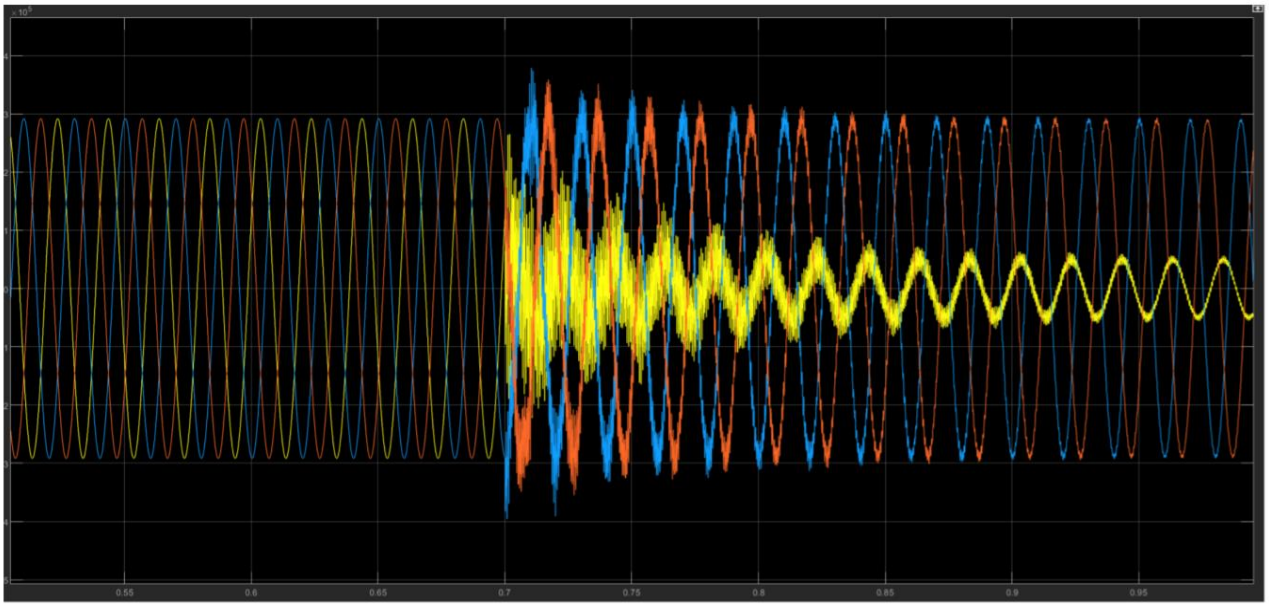
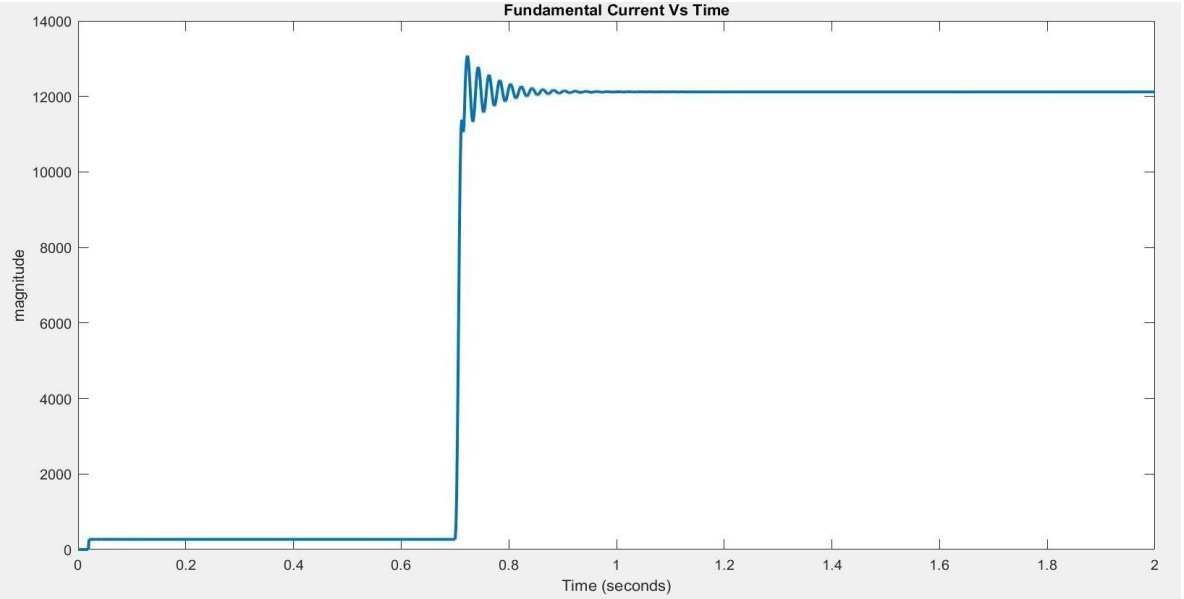


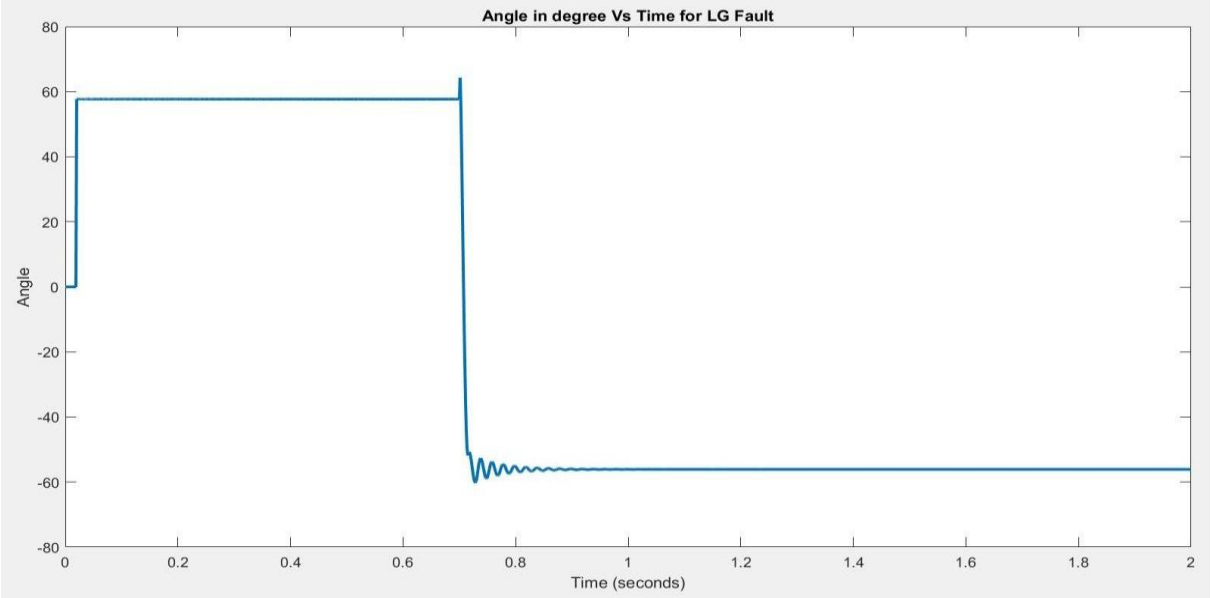
Fig-2: Plot the instantaneous voltage wave form of all the phases at bus B- 1 withsingle line to ground(A-G) fault at 50 Km from source- 1 with fault resistance of 0.1 Ohm at 0.7 second

(c) Plot Magnitude and phase angle of fundamental current of phase-A w.r.t time using Fourier Block in Simulink.

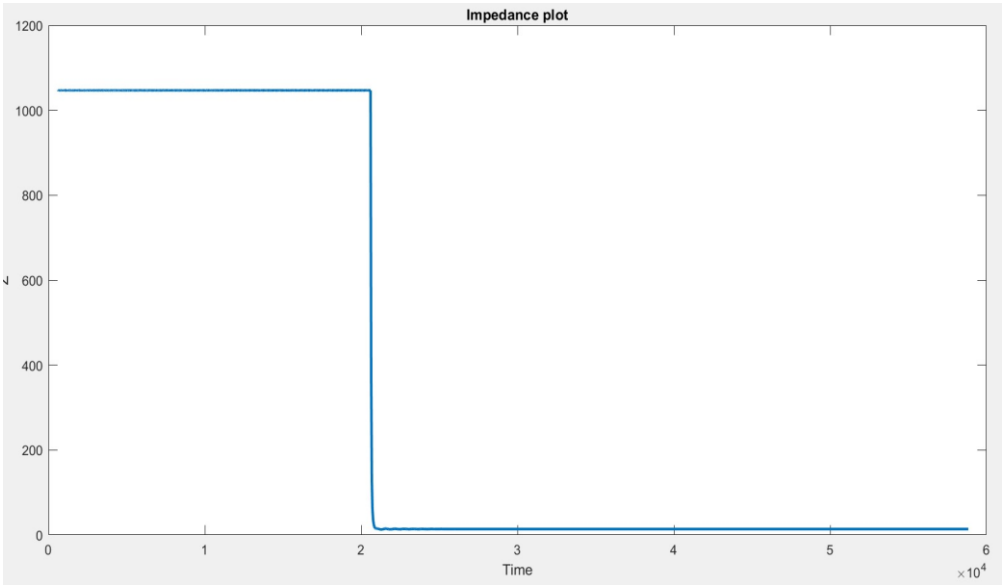
Magnitude:



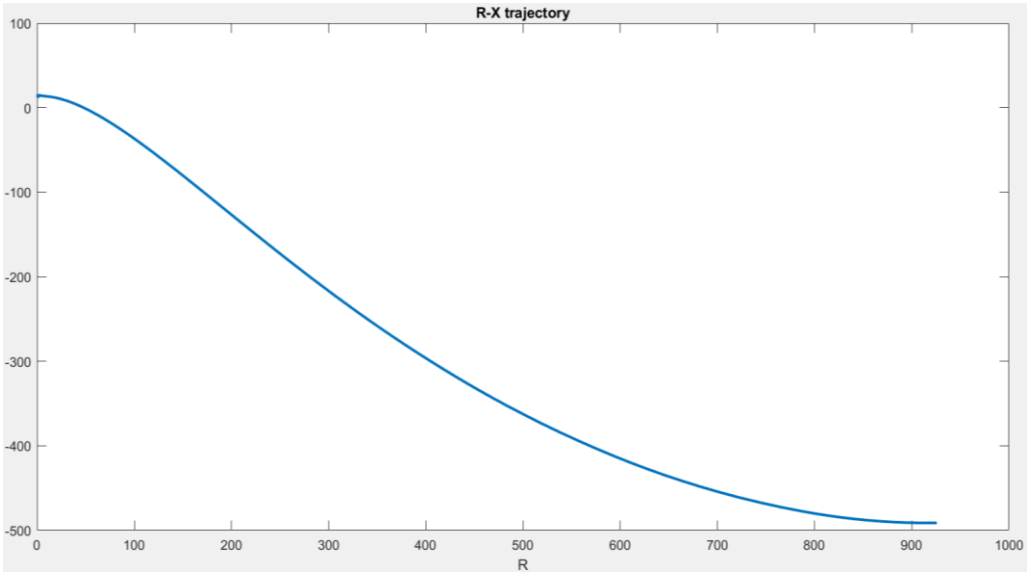
Phase:



(d) Plot the Impedance plot (Z Versus time). (Fault resistance = 0.1Ω)

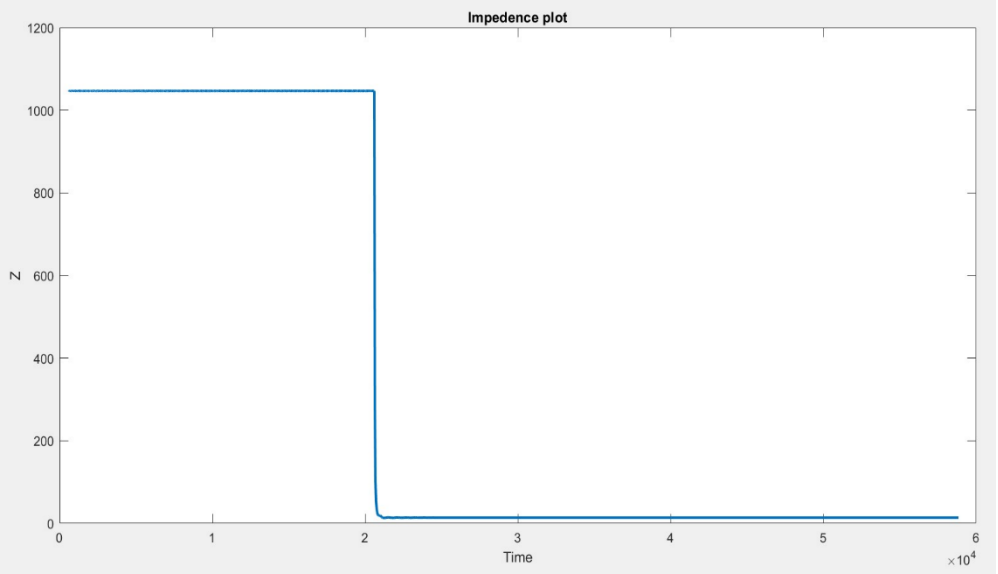


(e) Plot the R-X trajectory (Resistance Versus Reactance). (Fault resistance = 0.1Ω)

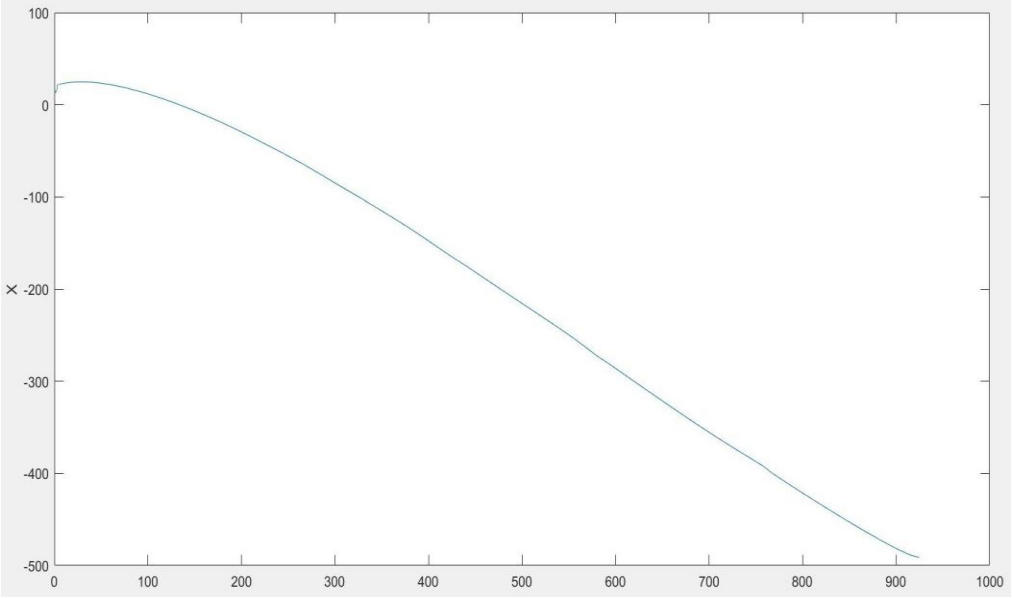


2. **L-L (A-B) fault (L-L impedance = 0.1Ω)** (Fault resistance = 0.1Ω)

Plot the Impedance plot (Z Versus time)

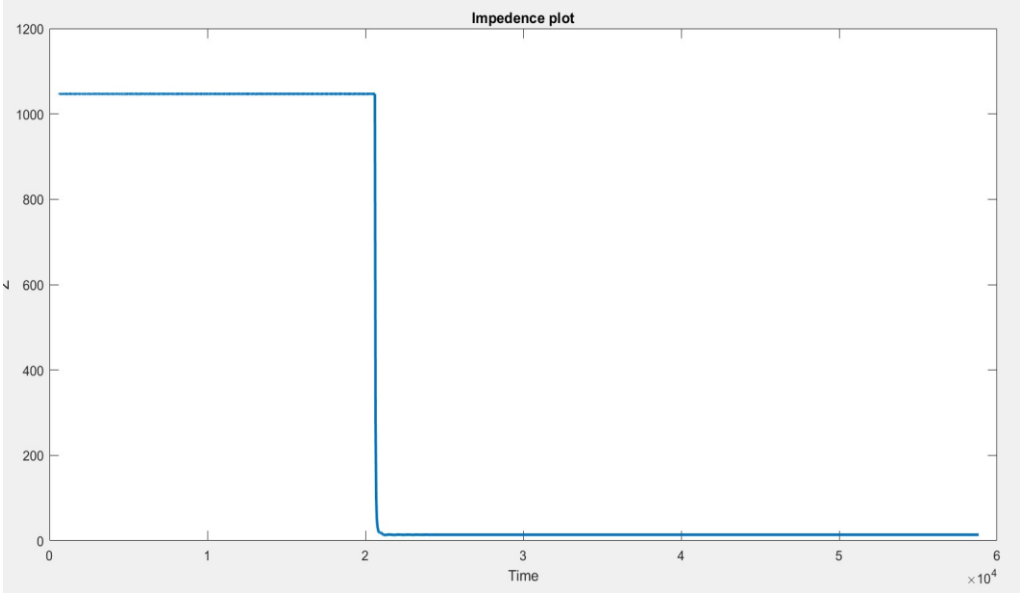


plot of R-X trajectory (Resistance Versus Reactance). (Fault resistance = 0.1Ω)

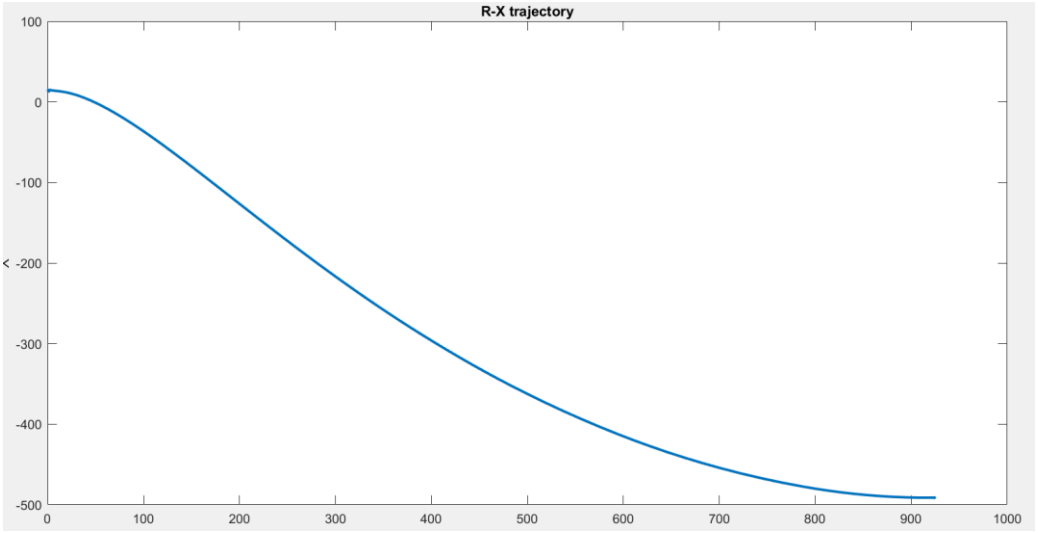


3. **L-L-G (A-B-G) fault. (Fault resistance = 0.1Ω)** (Fault resistance = 0.1Ω)

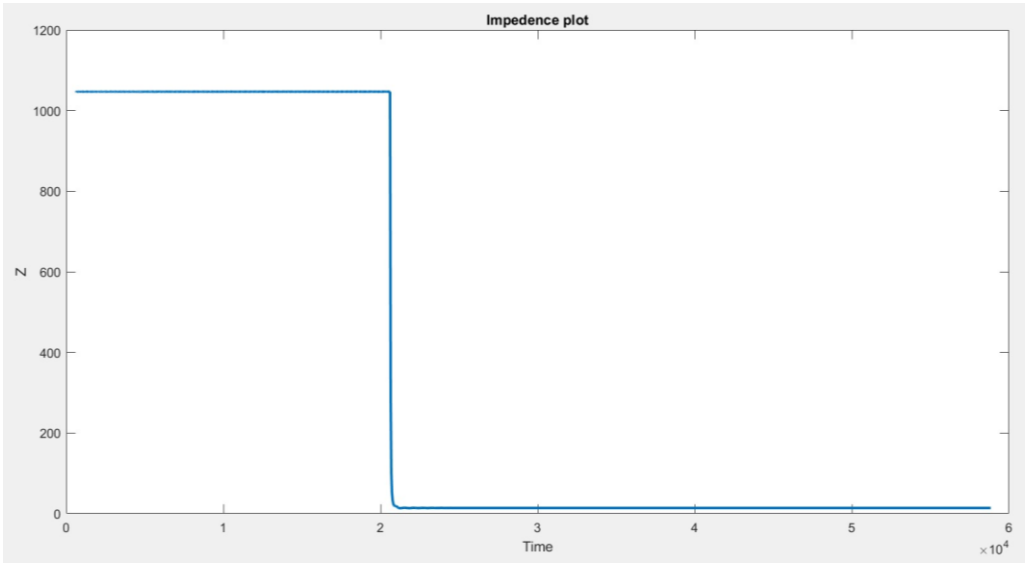
Plot the Impedance plot (Z Versus time)



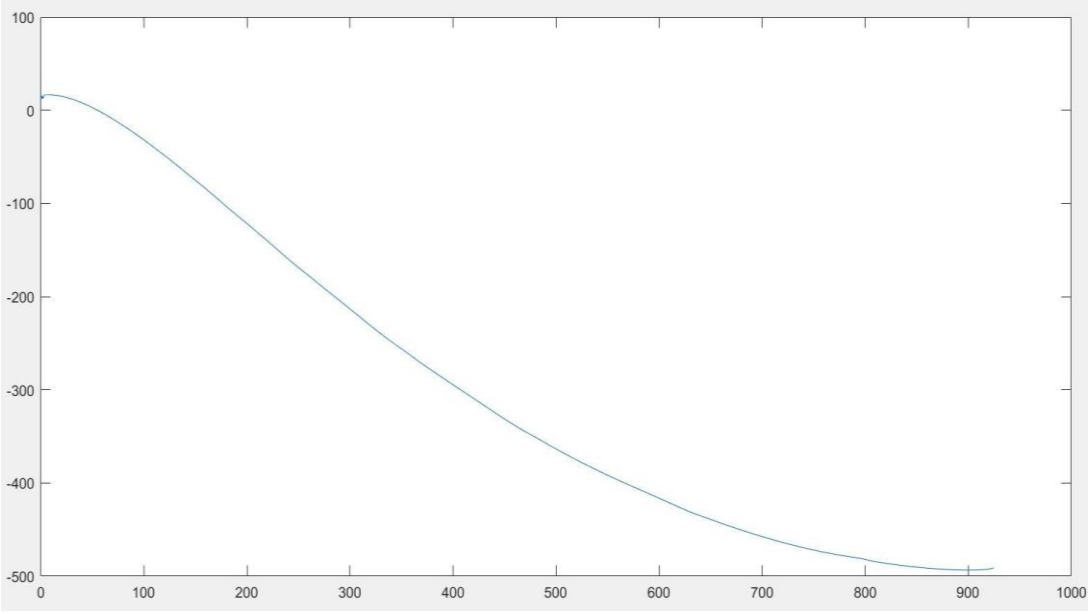
plot R-X trajectory (Resistance Versus Reactance).



4. L-L-L (A-B-C) fault. (Fault resistance = 0.1) Plot the Impedance plot (Z Vs time)

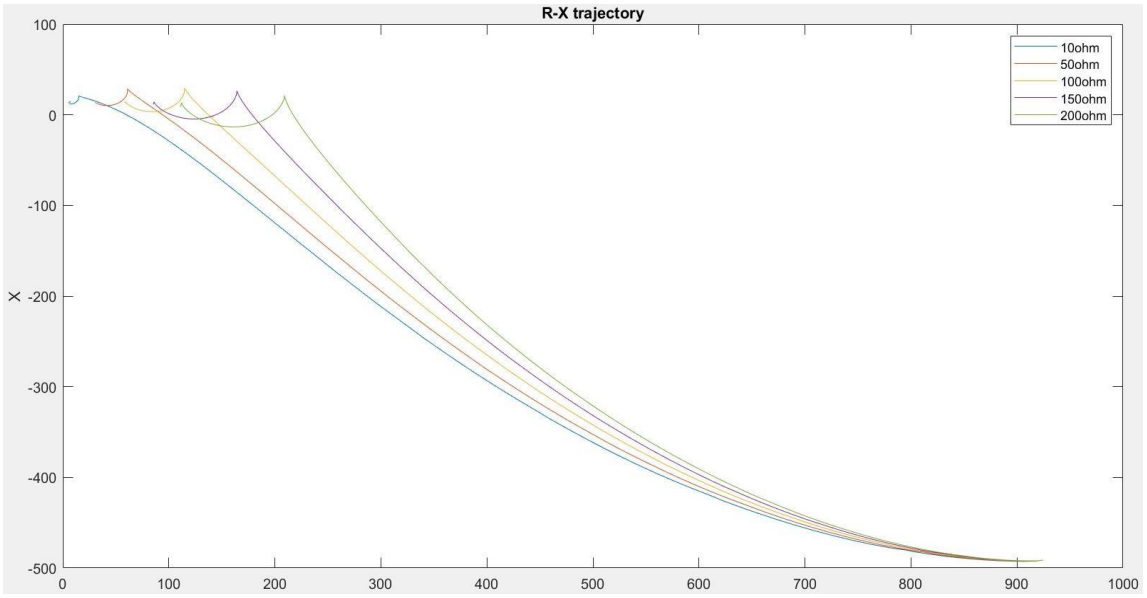


R-X trajectory (Resistance Versus Reactance).

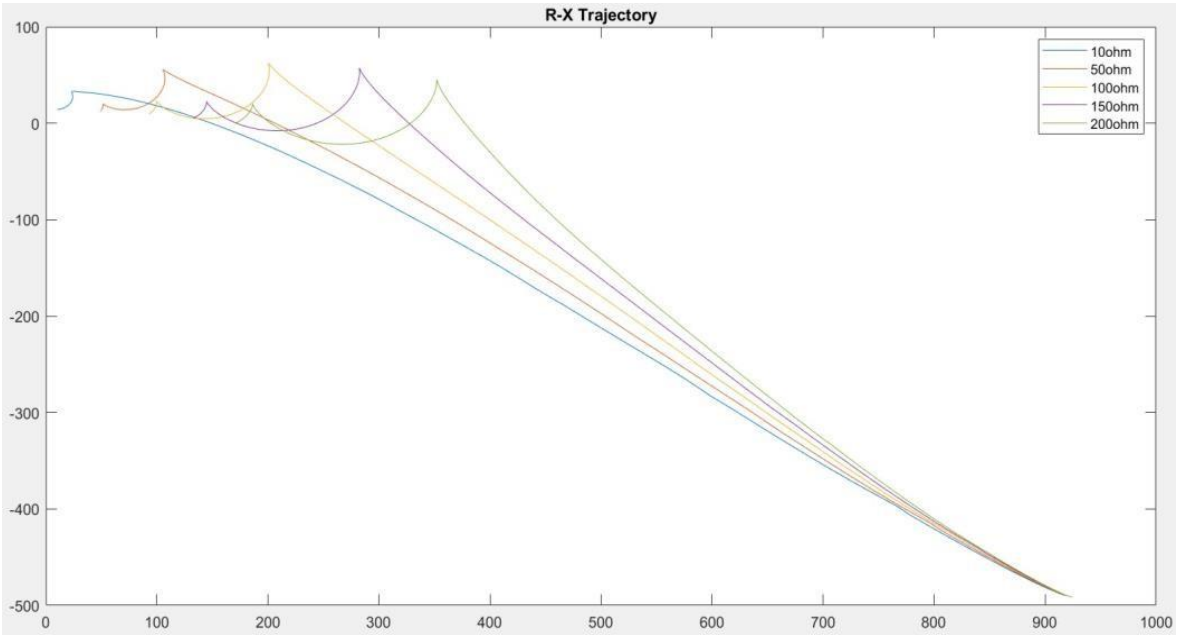


Case – II:

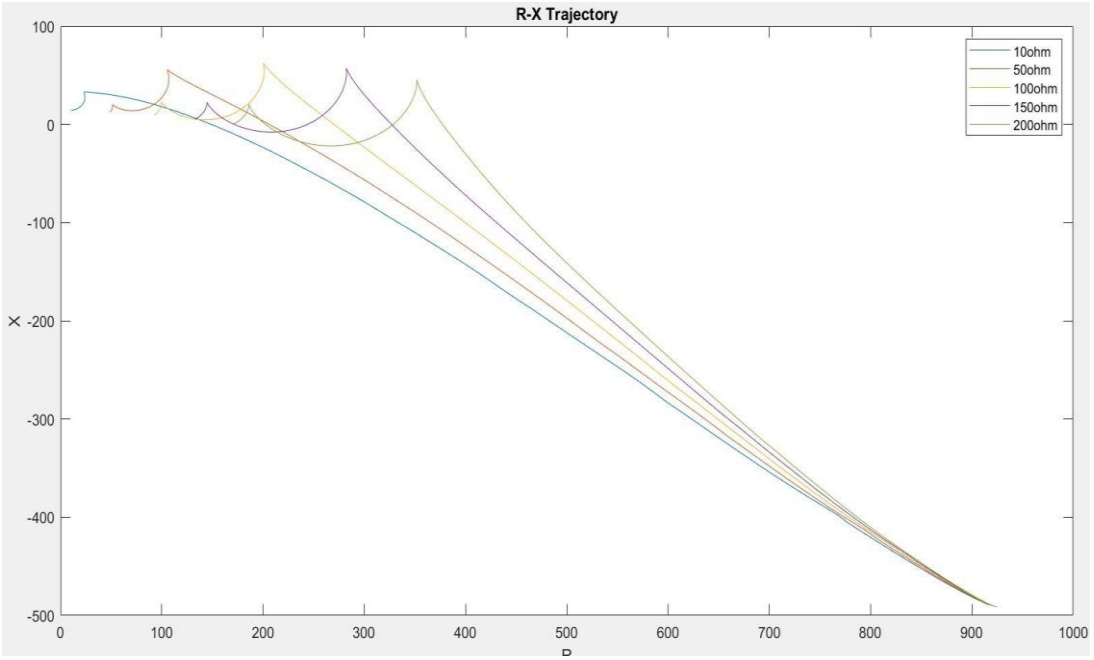
Impact of fault resistance on R-X trajectory. Rf = 10, 50, 100, 150, 200 (In ohms). for L-G fault. (Fault at 50 Km from source- 1)



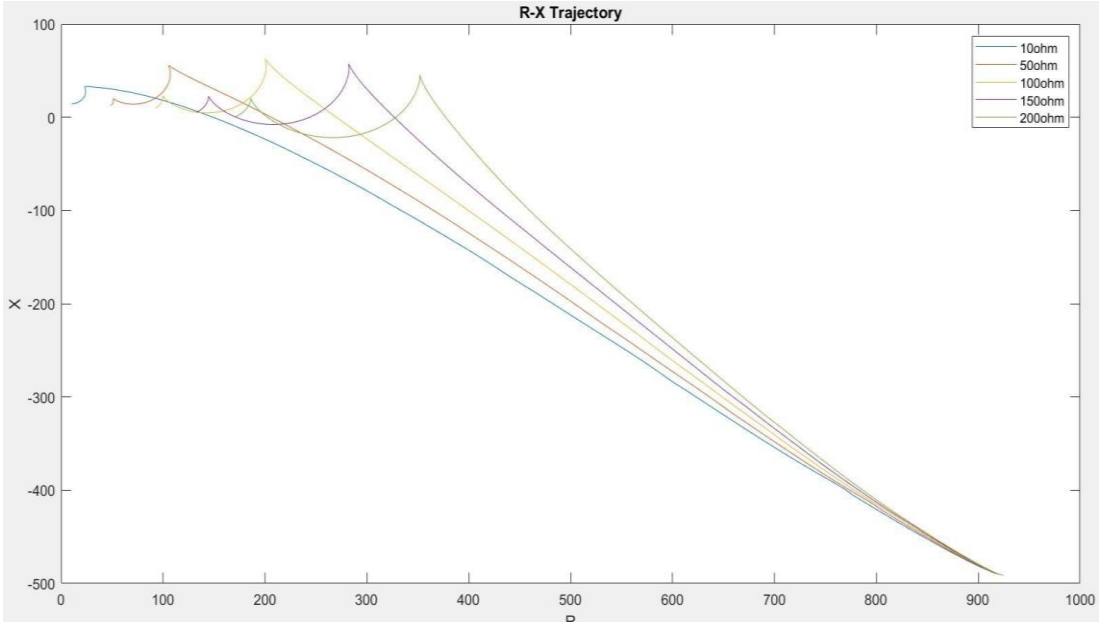
For L-L fault. (Fault at 50 Km from source- 1), R(L-L) = 10, 50, 100, 150, 200(In ohms).



For L-L-G fault. (Fault at 50 Km from source- 1), R(L-L) = R(L-G) 10, 50, 100, 150, 200 (In ohms).



For L-L-L fault. (Fault at 50 Km from source- 1), R(L-L-L) 10, 50, 100, 150, 200(In ohms).



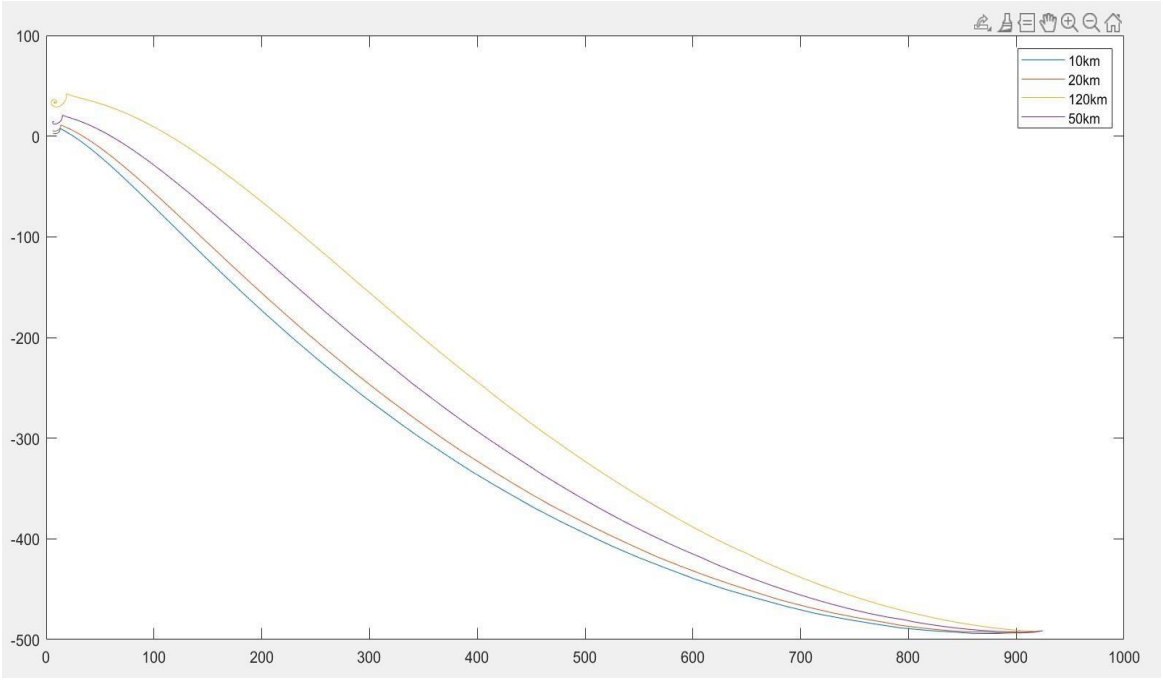
Case-III:

Types of fault	Fault Resistance(Ω)							
	10		50		100		200	
	R	X	R	X	R	X	R	X
No Fault	924.3	-491.3	924.3	-491.3	924.3	-491.3	924.3	-491.3
L-G	6.718	13.95	30.1	13.7	58.48	13.15	110.7	9.698
LL	6.718	13.95	30.1	13.7	58.48	13.15	110.7	9.698
LL-G	6.718	13.95	30.1	13.7	58.48	13.15	110.7	9.698
LLL	6.718	13.95	30.1	13.7	58.48	13.15	110.7	9.698

Case-IV:

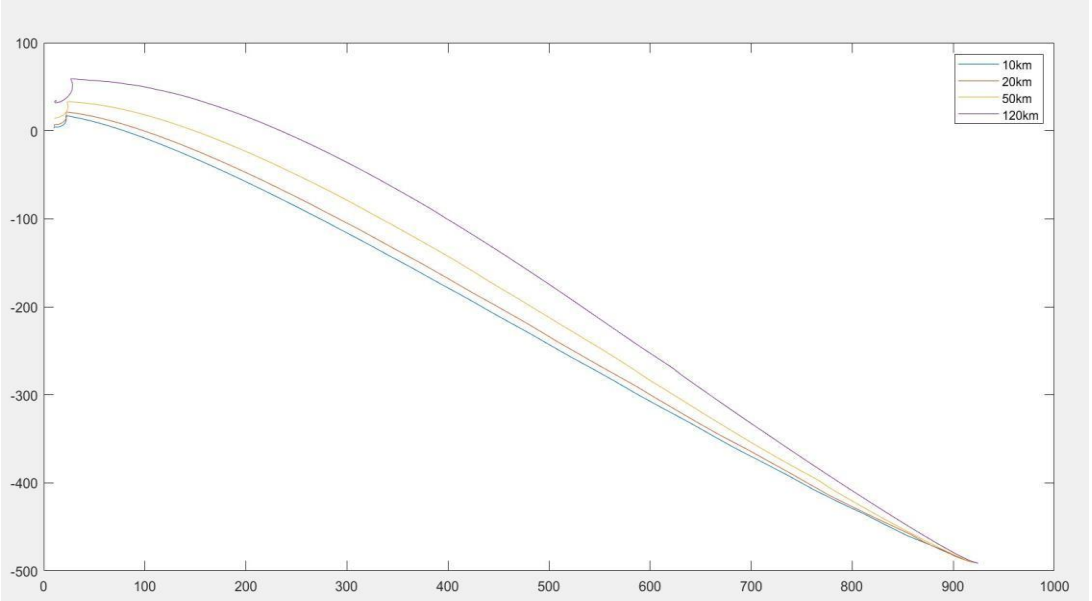
Impact of fault location on R-X trajectory. F_L = 10, 20, 50, 120 (In km).

(Fault resistance =10Ω) plots for L-G

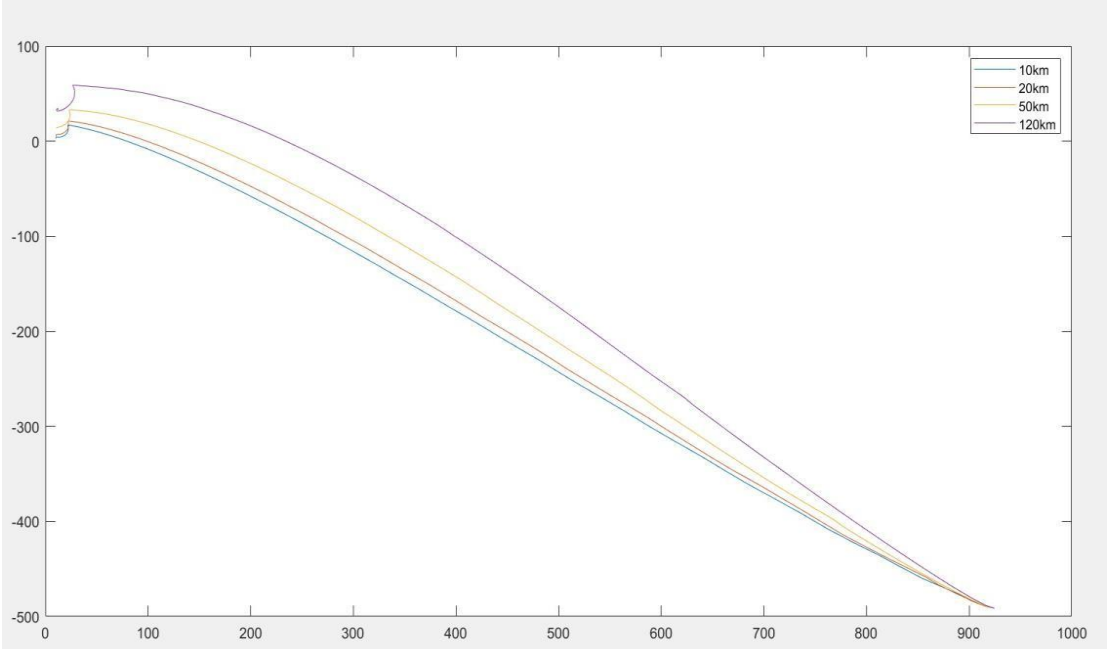


R

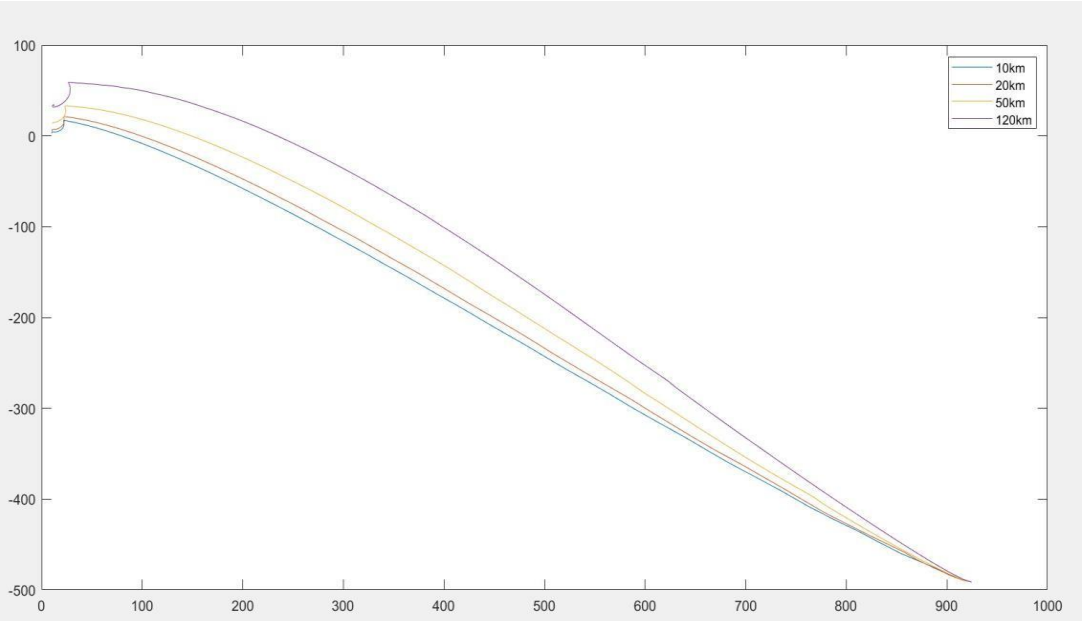
plots for L-L



plots for L-L-G



plots for L-L-L



Case-V:

Types of faults	Fault Location (KM)							
	10		20		50		120	
	R	X	R	X	R	X	R	X
No Fault	924.3	-491.3	924.3	-491.3	924.3	-491.3	924.3	-491.3
L-G	10.17	2.759	9.23	5.422	10.52	13.98	11.75	35.42
LL	10.17	2.759	9.23	5.422	10.52	13.98	11.75	35.42
LL-G	10.17	2.759	9.23	5.422	10.52	13.98	11.75	35.42
LLL	10.17	2.759	9.23	5.422	10.52	13.98	11.75	35.42

Conclusion

From this experiment we have seen that impedance of the transmission line decreases and it depends upon how far the fault is from the source.