

VNIT Nagpur

Fault Analysis MATLAB Application Documentation

Department: Electrical Engineering

Laboratory: Programming
Techniques and Simulation

Title of Application: Transmission
Line Fault Analysis Tool

Developed by: Manjeet .A. Singh

Roll No.: BT23EEE112

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Brief Description

Objective:

This MATLAB application is designed to analyze and simulate different types of faults in transmission lines, helping users understand fault currents, severity, and mitigation strategies.

Features

- **Balanced Fault Analysis:** Computes three-phase symmetrical faults. Fault Power and Fault Current
- **Unbalanced Fault Analysis:** Supports Line-to-Ground (LG), Line-to-Line (LL), and Double Line-to-Ground (LLG) faults.
- **Interactive GUI:** User-friendly interface with input fields for system parameters.
- **Visualization:** Displays fault current magnitude and plots current waveforms.
- **Educational Content:** Includes theory sections explaining fault types and analysis methods.
- **Displays analysis report** for the fault

Applications

- Useful for power system engineers, students, and researchers.
- Helps in designing protection systems (relays, circuit breakers).
- Provides insights into fault severity and mitigation.

2. Block Diagram

System Workflow

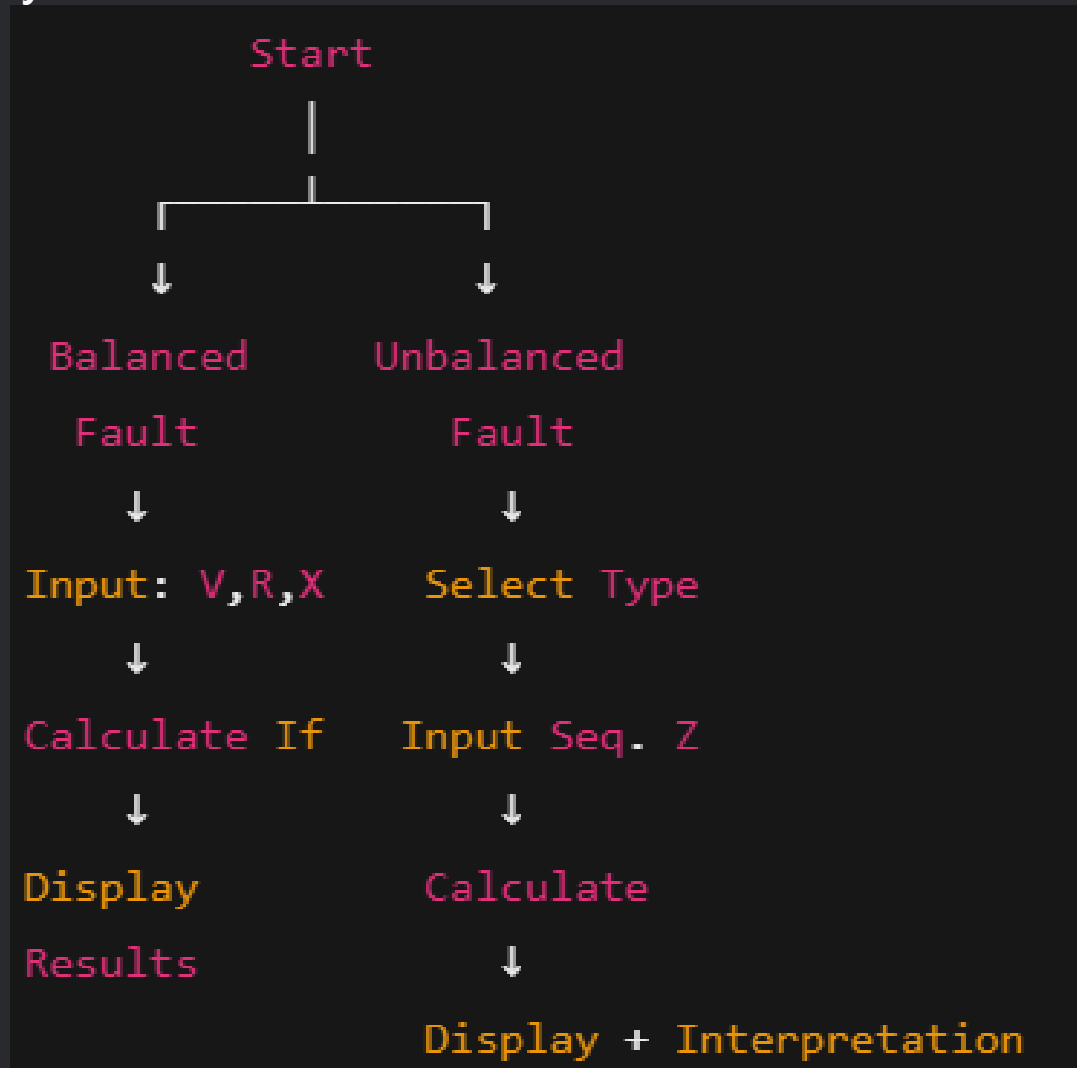
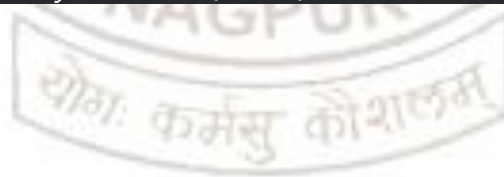


Fig 1: System workflow of the Fault Analysis App



3. Screenshots with Explanation

Screenshot 1: Main Menu

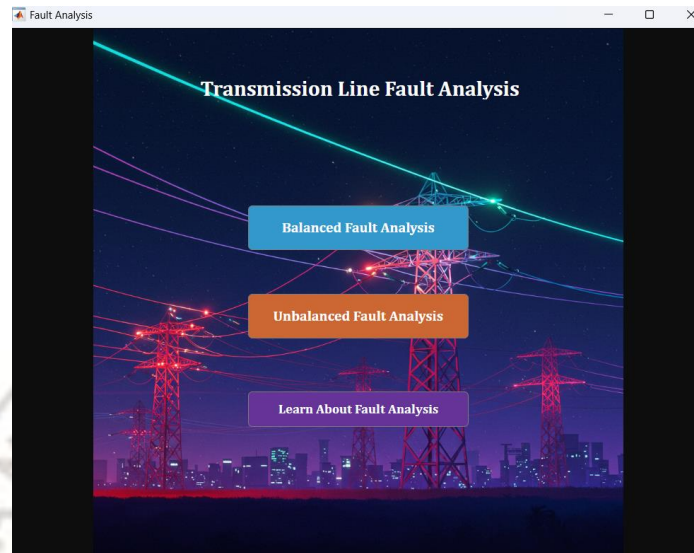
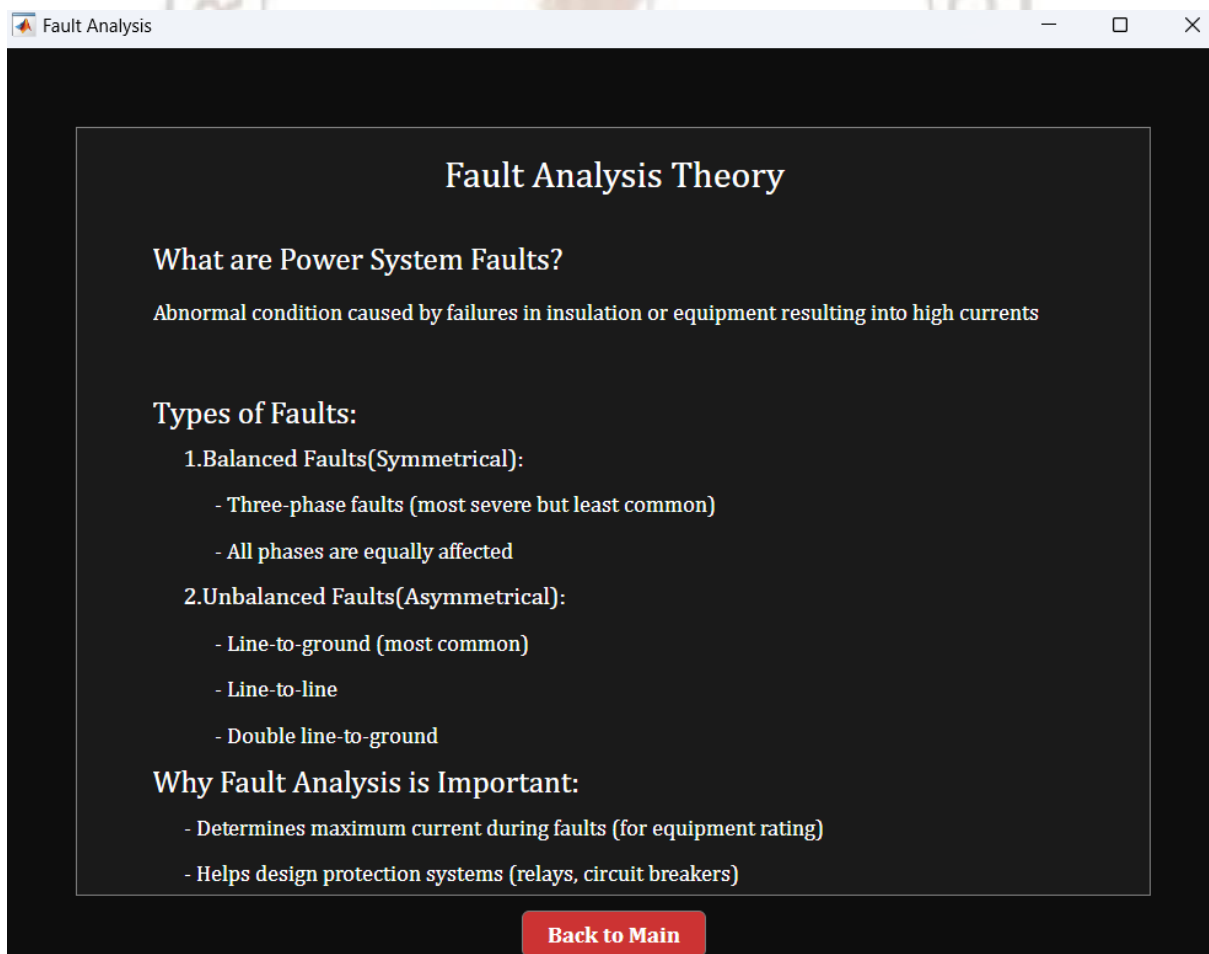
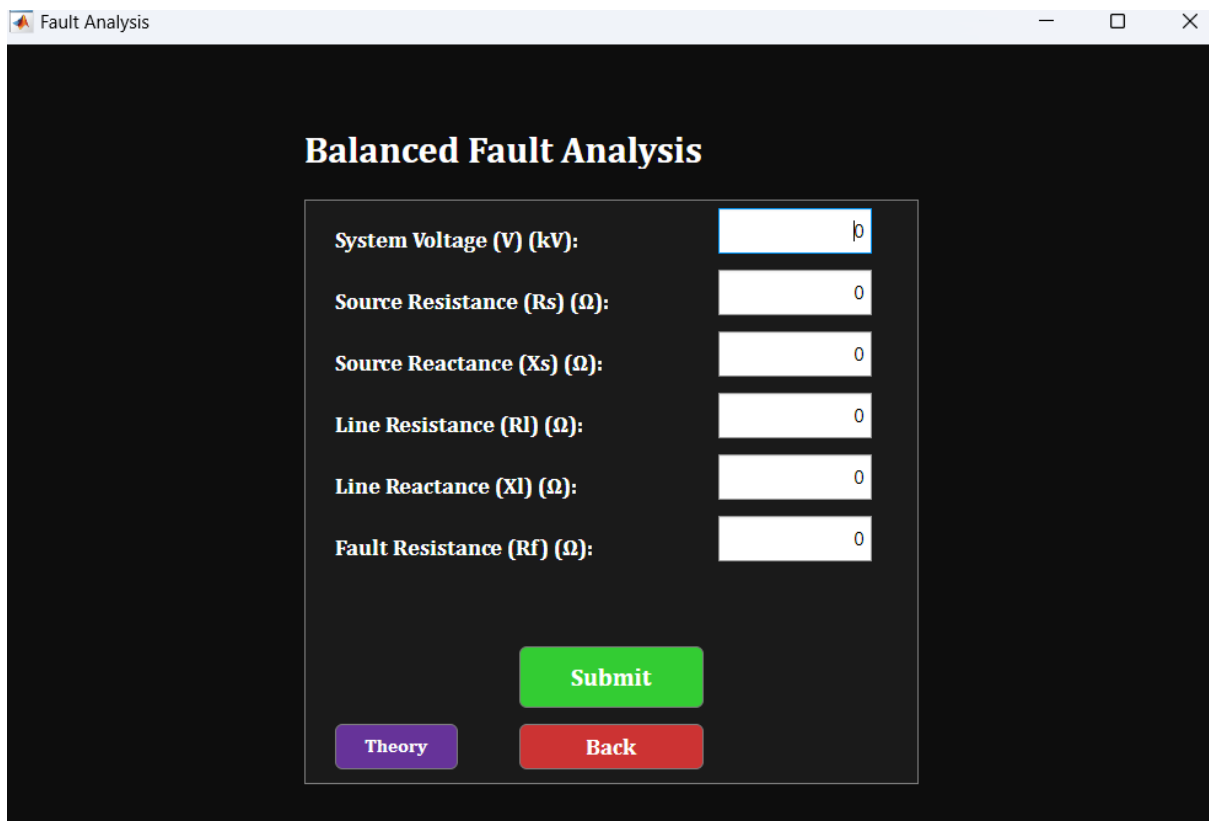


Fig 2: Home screen with options for fault analysis and theory.



Screenshot 2: Balanced Fault Input

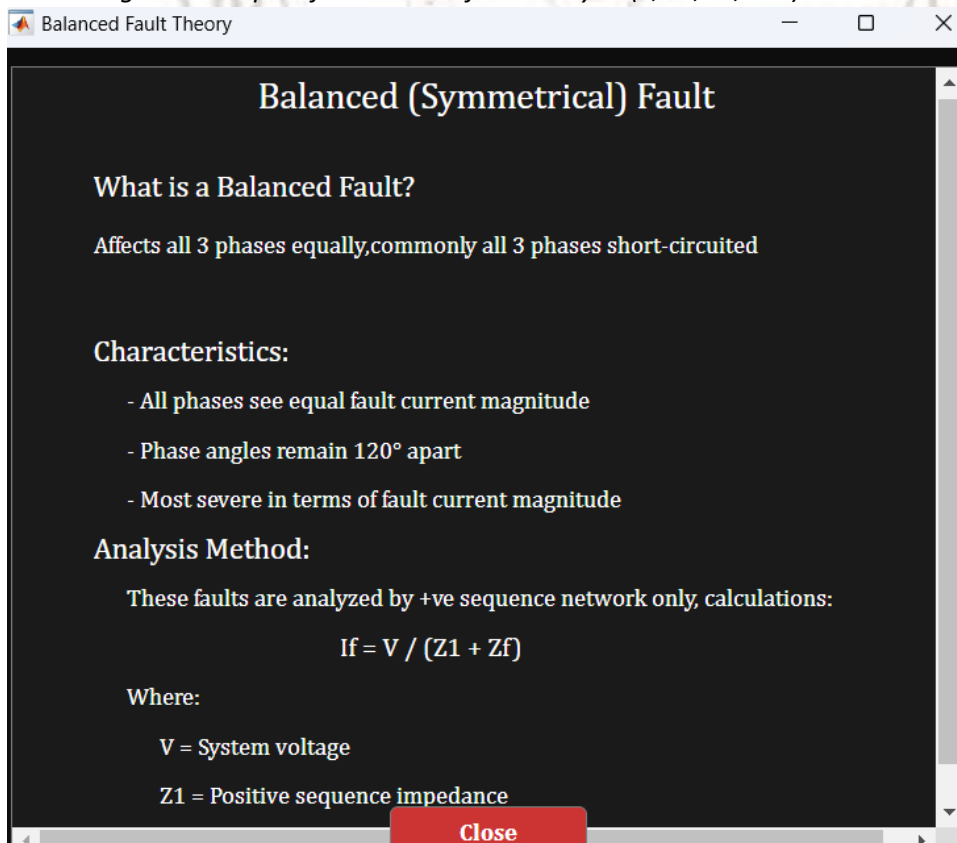


The screenshot shows a web application window titled "Fault Analysis". Inside, there is a section titled "Balanced Fault Analysis". This section contains a list of input parameters, each with a label and a corresponding text input field. The parameters are: System Voltage (V) (kV), Source Resistance (Rs) (Ω), Source Reactance (Xs) (Ω), Line Resistance (Rl) (Ω), Line Reactance (Xl) (Ω), and Fault Resistance (Rf) (Ω). The input fields for Rs, Xs, Rl, Xl, and Rf all contain the value "0". The input field for System Voltage (V) (kV) contains the value "10". Below the input fields, there are three buttons: a green "Submit" button, a purple "Theory" button, and a red "Back" button.

Parameter	Value
System Voltage (V) (kV):	10
Source Resistance (Rs) (Ω):	0
Source Reactance (Xs) (Ω):	0
Line Resistance (Rl) (Ω):	0
Line Reactance (Xl) (Ω):	0
Fault Resistance (Rf) (Ω):	0

Buttons: Submit, Theory, Back

Fig 3: User inputs for balanced fault analysis (V, Rs, Xs, etc.). & can read the theory as well



The screenshot shows a web application window titled "Balanced Fault Theory". Inside, there is a section titled "Balanced (Symmetrical) Fault". This section contains text explaining what a balanced fault is, its characteristics, and the analysis method. The text is as follows:

Balanced (Symmetrical) Fault

What is a Balanced Fault?

Affects all 3 phases equally, commonly all 3 phases short-circuited

Characteristics:

- All phases see equal fault current magnitude
- Phase angles remain 120° apart
- Most severe in terms of fault current magnitude

Analysis Method:

These faults are analyzed by +ve sequence network only, calculations:

$$I_f = V / (Z_1 + Z_f)$$

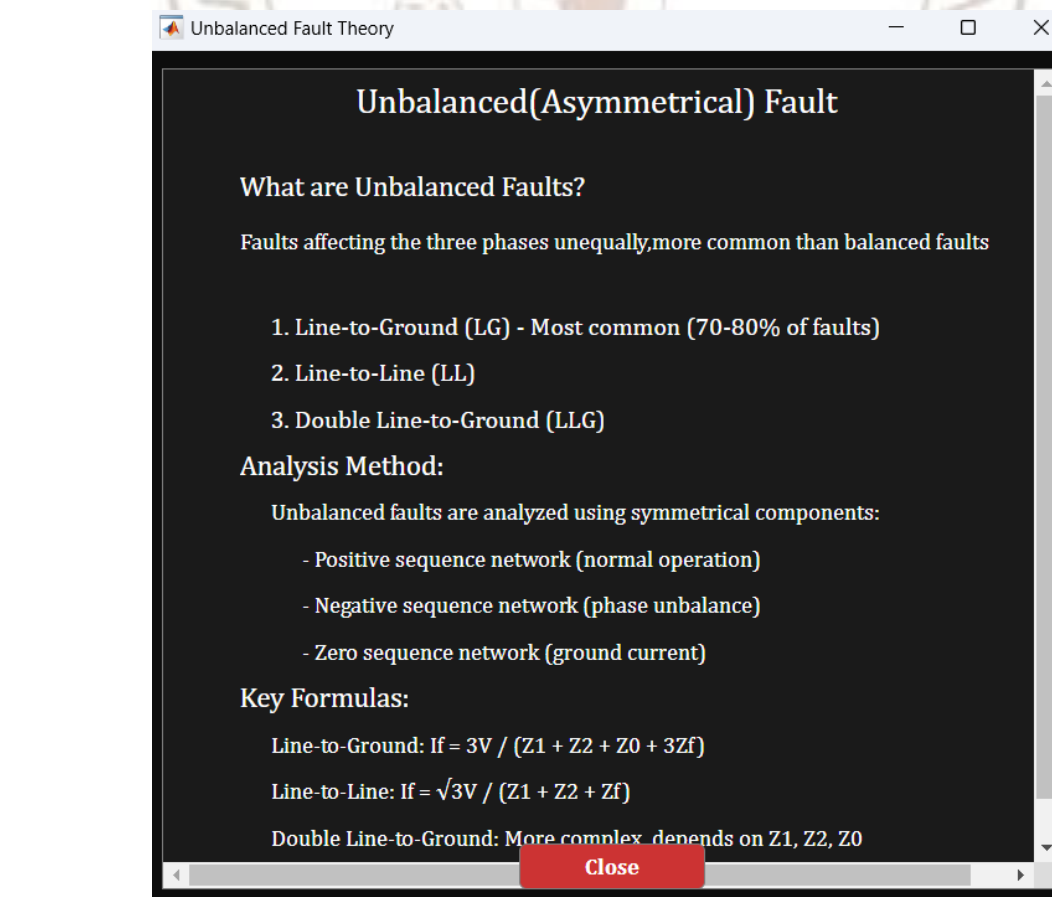
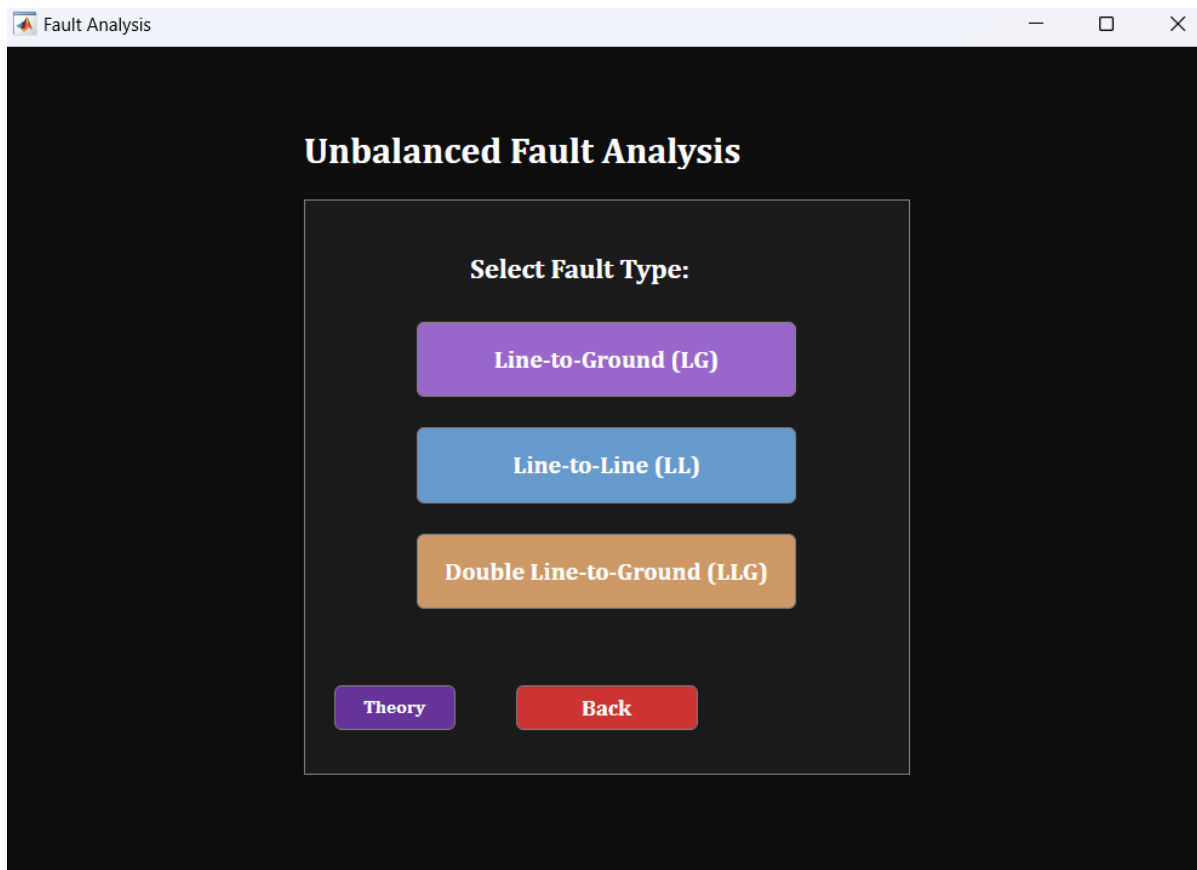
Where:

V = System voltage

Z1 = Positive sequence impedance

Buttons: Close

Similarly the user can do the analysis for unbalanced all 3 cases as well with theory of each



Screenshot 3: Unbalanced Fault Results after Giving inputs for LL fault

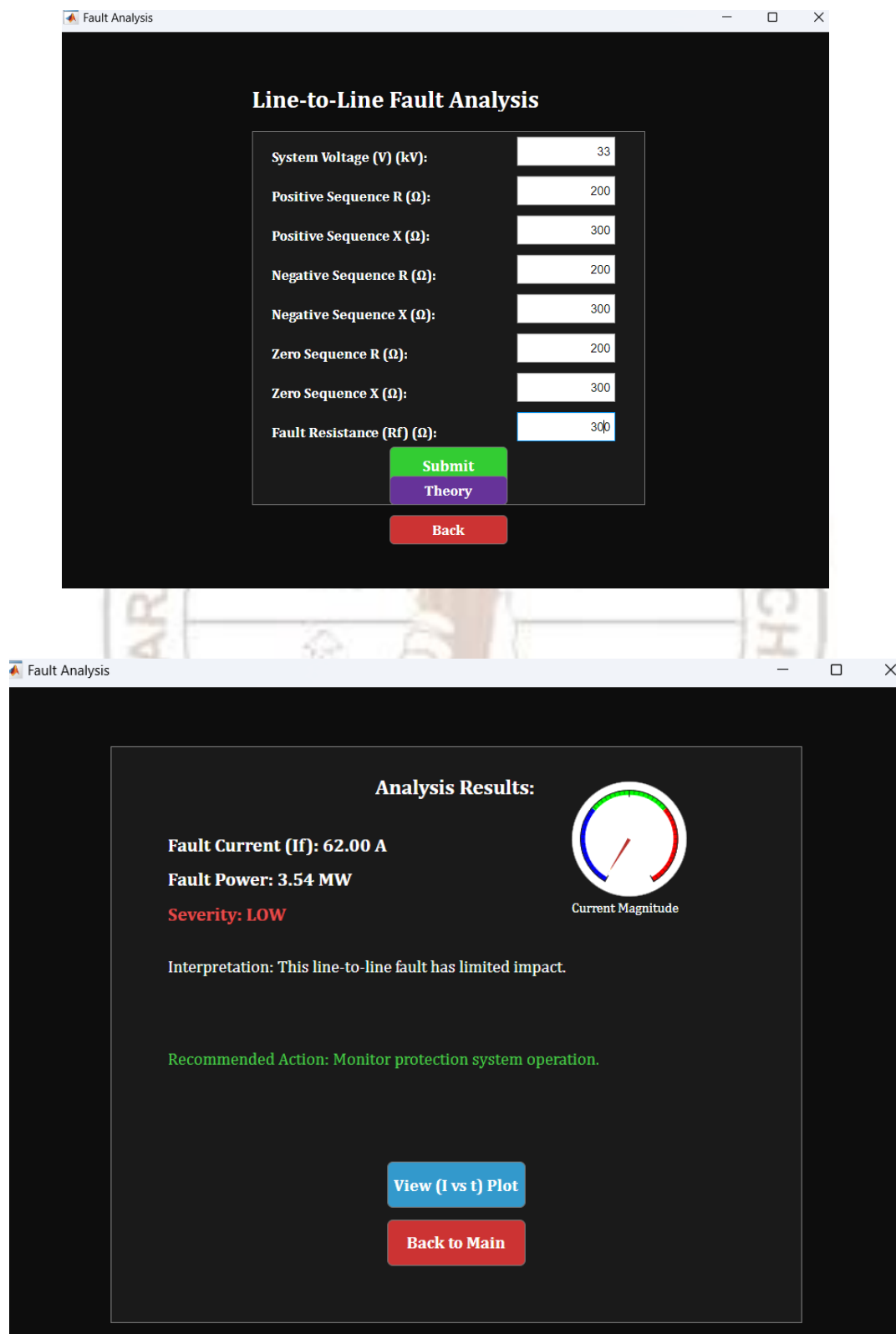
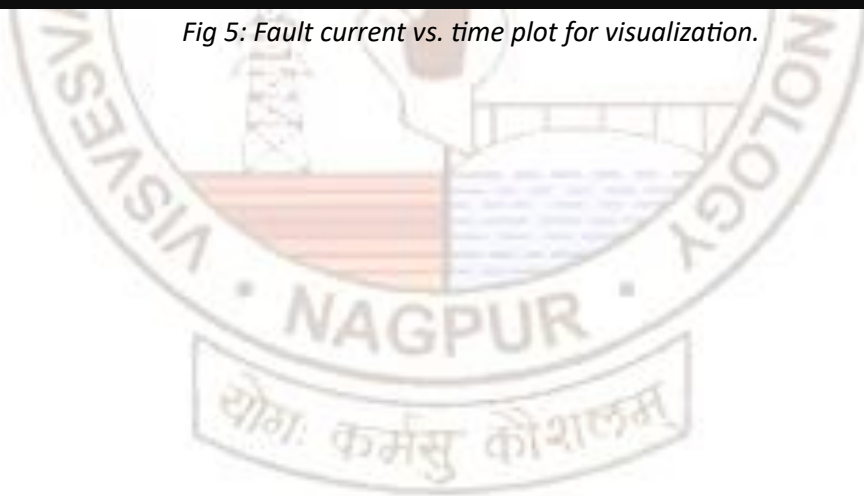


Fig 4: Results showing fault current, severity, and recommended actions with current gauge

Screenshot 4: Current Plot after clicking on View (I vs t) Plot



Fig 5: Fault current vs. time plot for visualization.



4. Conclusions & Remarks

- *The app effectively calculates fault currents for both balanced and unbalanced scenarios.*
- *Provides actionable insights (e.g., "VERY HIGH severity – check circuit breakers").*
- *Can help to recall the theory and formulae while doing analysis*
- *GUI makes it accessible for students and engineers.*

Future Scope

- *Add support for arc faults and transient analysis.*
- *Include a library of standard transmission line parameters.*

