# Transmission Line Effects Analysis Using Matlab GUI

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*Abstract*— **Transmission lines carry electricity from the point of generation to distant points of utilization. The performance of power system components are not ideal because of losses or electromagnetic effects. Losses occur due to conductor resistance, leakage through the inductive resistance and capacitive leakage. Voltage-drop, bad regulation, decrease in efficiency etc., are electromagnetic effects caused in transmission lines specially when distances are long.**

**MATLAB based Graphical User Interface (GUI) has been designed to demonstrate the behavior of transmission line for different load conditions and operating parameters input through GUI by user. As per user input of key parameters, GUI numerically calculates and displays various performance parameters of transmission lines. GUI also display influence of physical effects like Ferranti effect, Skin effect, Proximity effect and corona loss etc., on transmission of power. This GUI help to understand about transmission line.**

**This GUI will be helpful for engineering students, educators and professionals who are involved in designing reliable and efficient transmission lines.**

## I. INTRODUCTION

Modern electrical grids are growing fast, and with that it comes a bigger need for high-voltage power transmission. Power engineers need to understand how transmission lines behave, since these lines connect power generation plants and distribution centers. Their performance depends on a mix of electrical and mechanical factors. As the development of high-voltage and long-distance transmission line system, the effects like Ferranti effect, Skin effect, Proximity effect, Corona discharge are giving great challenges to the power engineers. These effects are analyzed by rigorous mathematical models and manual calculation traditionally, which takes much time and can't provide visualizations for complex networks such as double circuit transmission lines. The emergence of computational tools and GUI leads an innovation in industrial design and education because of complex analysis needed.

This project brings in an interactive MATLAB tool-a platform to simulate and analyze single and double circuit lines. The GUI gives instant calculations and graphs, and a complete picture of how the lines are performing.

## II. SOFTWARE REQUIREMENTS

This app is built in a modular way and uses several MATLAB technologies:

1. MATLAB App Designer: The core framework used to build the matlab.apps.AppBase. It provides the uifigure window and the grid layout managers used for responsive design.
2. UI Component Library with Interactive Controls: Sliders, Drop-downs, and Numeric Edit fields for real time parameter tuning.
   - Navigation
   - UI Axes for plotting 2D waveforms and Mechanical sag.
   - 3D Visualization for Proximity effect.
3. Math & Optimization is for MATLAB built-in functions for matrix operations (ABCD parameters) and Bessel functions for Skin effect calculations.

## III. WORKING OF PROPOSED SYSTEM

The working of the system is centered on an event-driven execution model where a GUI functions as the primary control for a mathematical backend. When the app opens, the system configures all UI components and inside the system, an internal library with all types of conductors, like ACSR Zebra AAAC etc.

Interface connects everything like sliders, drop-downs edit text fields all together and after giving input parameters, it starts working on backend. It separated into two kinds of calculations: electrical and mechanical. On electrical side, it pulls out constants for selected conductor and it computes all line parameters, and builds the ABCD transmission matrix. The system figure out that how efficiently the line is running and how the voltage holds up, and it even considers the electromagnetic behavior. On the mechanical side, it checks the wind pressure or ice buildup and give the sag expected.

Finally, everything calculated by the system is sent back to the main dashboard and it plots all values and updated graphs into multiple tabs and 3D magnetic field visuals, voltage profiles, and safety curves in real time.

## IV. DESIGN OF PROPOSED SYSTEM

The design of the proposed system is given below.

Implementation in MATLAB:

1. Open MATLAB R2025a.
2. There is a menu bar at the top.
3. In the menu bar, click on the apps tab. Then click on the ‘Design App’ button.
4. When you click design app, MATLAB goes into a new page for designing apps.
5. Click on Blank App. There will be an interface, like in the image below.

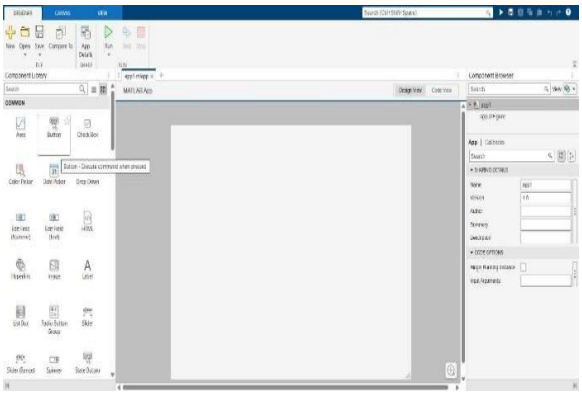

Fig 1. App designer interface

6. Drag the tools from the component library onto the interface and arrange them so that they are easy to find.

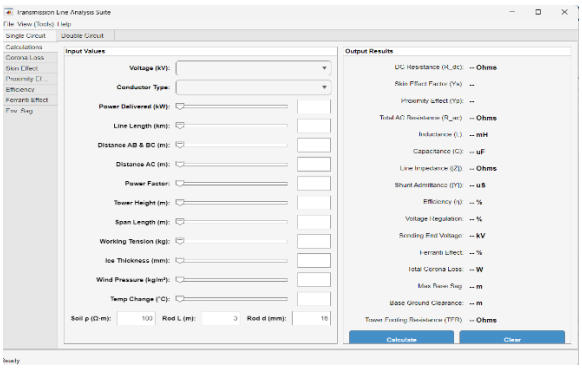

Fig 2. Single circuit interface

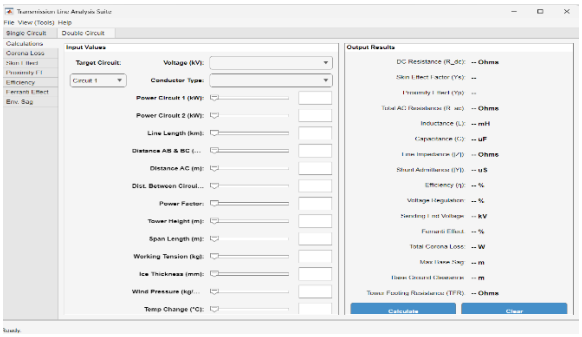

Fig 3. Double circuit interface

7. Write the required formulas for each effect in the MATLAB script
8. Save the file.
9. Run the file and see the results.

## V. RESULTS

This paper is developed using MATLAB GUI, which helps with smart-calculations for single circuit and double circuit with corona, proximity, skin, Ferranti effects and normal calculations like efficiency, sag, voltage regulation. The method described in this paper allows the system function to work as a dynamic planning environment for optimizing conductor selection and circuit configurations by balancing electrical capacity with mechanical constraints. It serves as virtual laboratory for educational purposes, converting abstract concepts into interactive visual models that allow for real time sensitivity analysis of grid stability.

The following shows the results for single circuit:

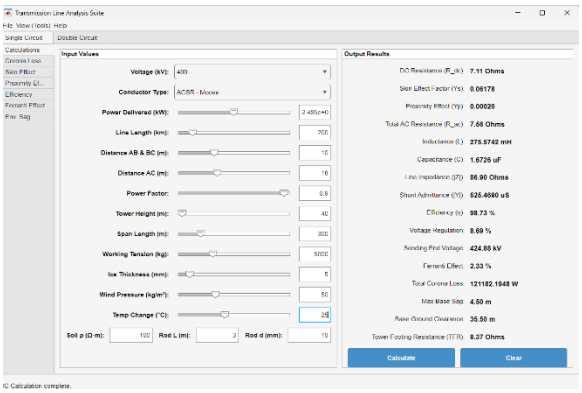

Fig 4. Single circuit calculations

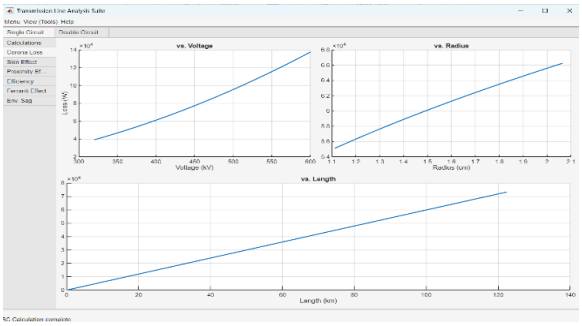

Fig 5. Corona loss

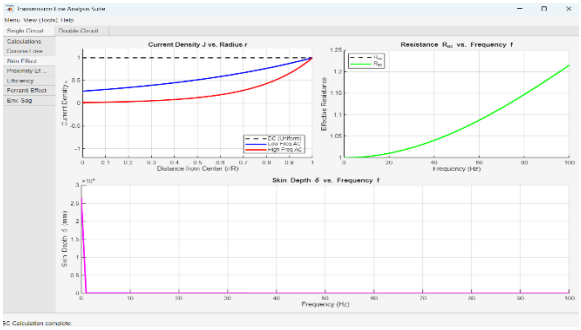

Fig 6. Skin effect

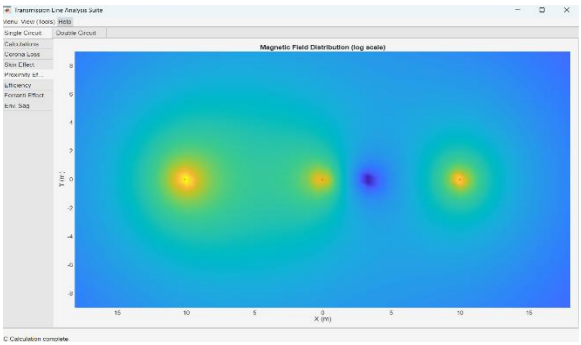

Fig 7. Proximity effect

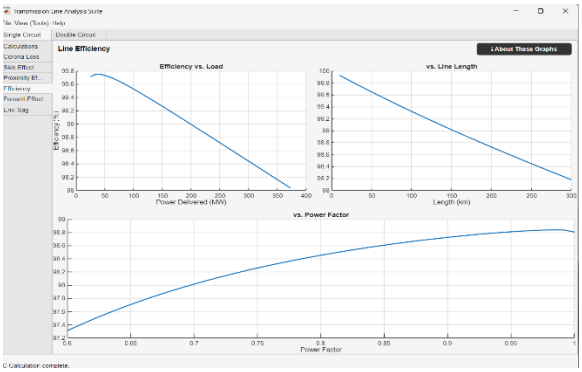

Fig 8. Efficiency

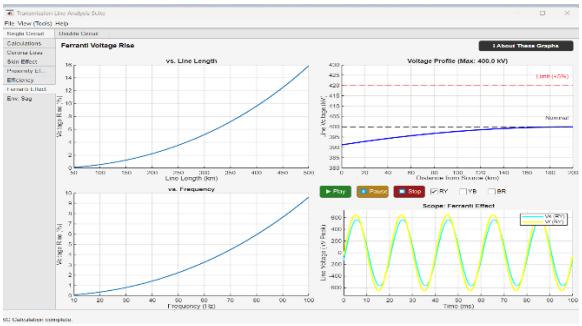

Fig 9. Ferranti effect

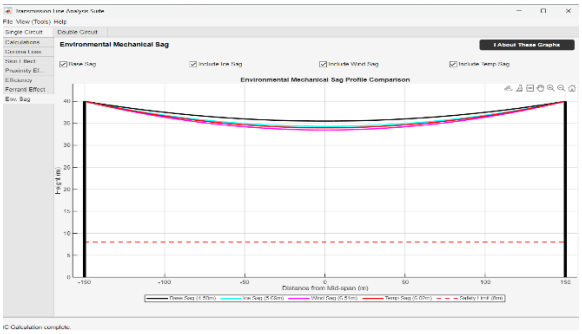

Fig 10. Sag

The following shows the results for double circuit:

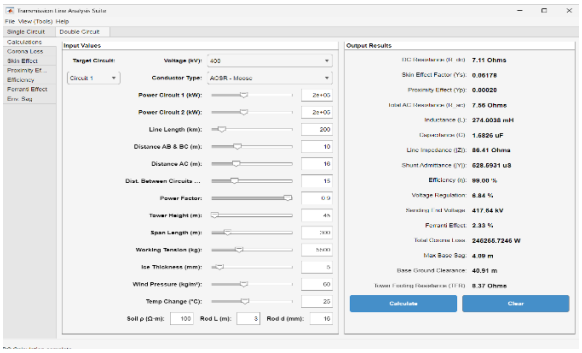

Fig 11. Double circuit calculations

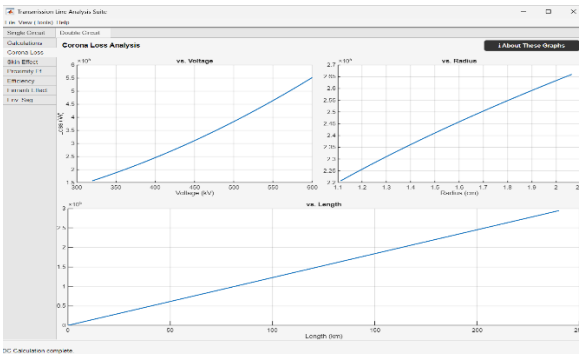


Fig 12. Corona loss graphs

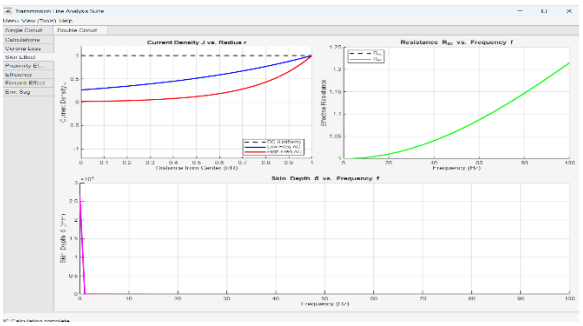


Fig 13. Skin effect graphs

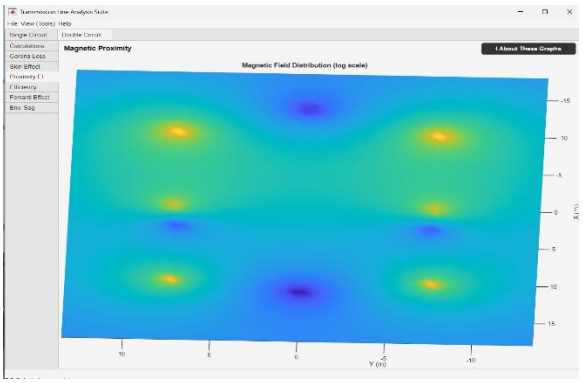


Fig 14. Proximity effect

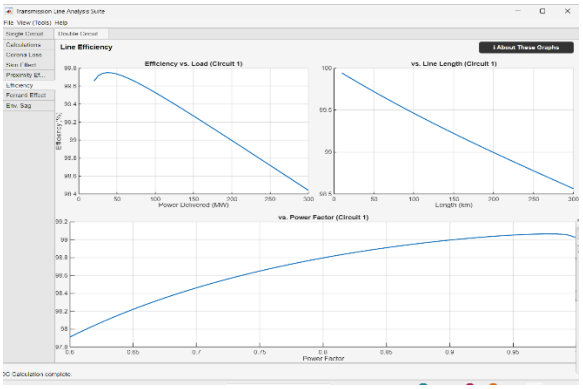


Fig 15. Efficiency

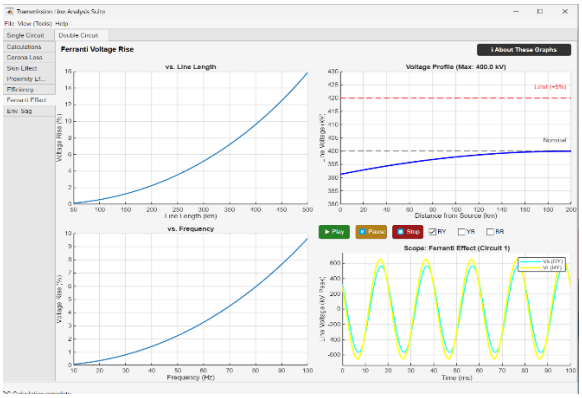


Fig 16. Ferranti effect

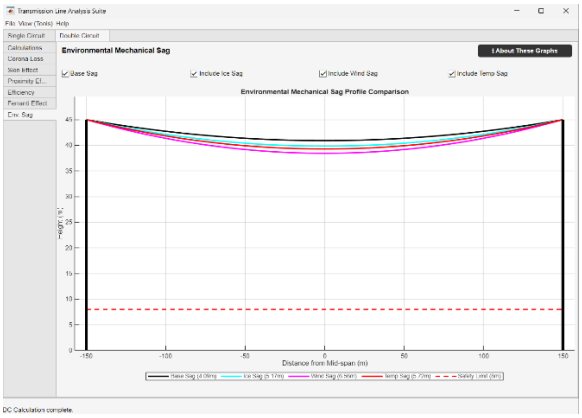


Fig 17. Sag

When you click on help tab it shows:

- Theory Reference
- User Guide
- About this App

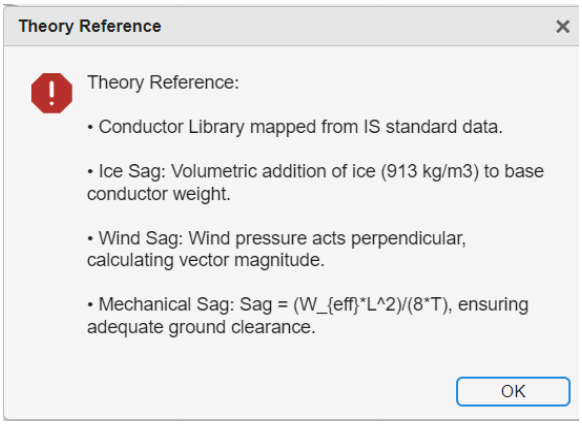


Fig 18. Theory Reference

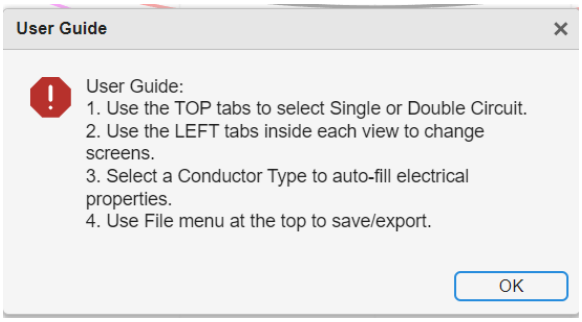


Fig 19. User Guide

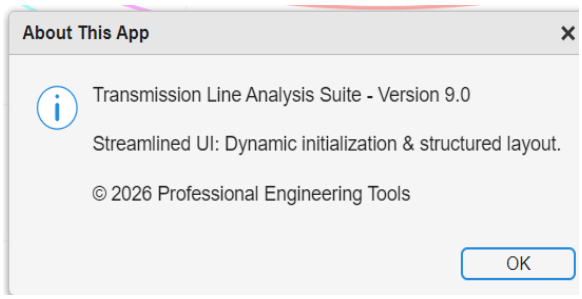


Fig 20. About this App

When you click on menu tab it shows as below:

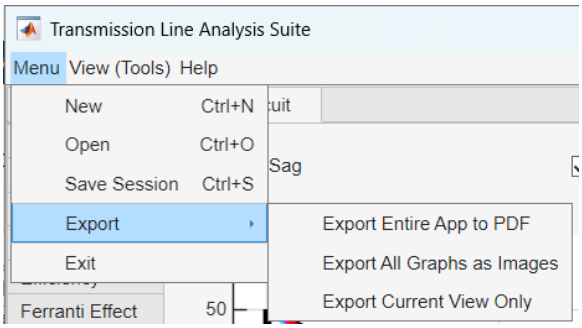


Fig 21. Menu button

When you click on view tab it shows as below:

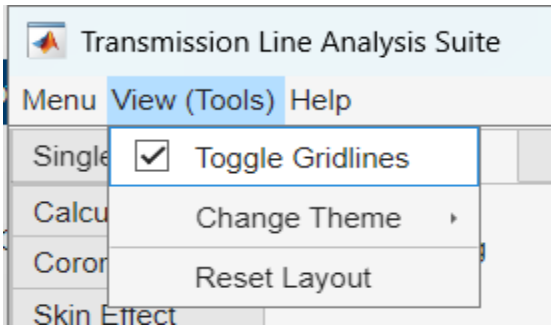


Fig 22. View button

## VI. CONCLUSION

In conclusion, the creation of this MATLAB-based simulation tool offers a strong and comprehensive method to analyze transmission line properties. Combining several important aspects of the power systems including Ferranti effect, Skin effect, Proximity effect, Corona loss, as well as sag and tension modelling, the developed project successfully combines the knowledge about power systems with visual representations. Moving from static analysis to dynamic one that can be performed through the interactive GUI interface provides an opportunity to understand hoe different conditions affect the efficiency of power lines in real-time.

As it could be seen from the obtained results, the proper operation of the power grid is only possible with combination of electromagnetic and mechanical integrity. This provided application could serve as the educational tool as well as an industrial one.

## REFERENCES

[1] Modern Power System Analysis – D.P. Kothari & I.J. Nagrath.
[2] C. L. Wadhawa, Electrical Power Systems, New age International.
[3] Power System Analysis – Hadi Saadat..
[4] "Graphical user interface-based model for transmission line performance" Indonesian Journal of Electrical Engineering.power.
[5] I. A. Montoya "MATLAB GUI as assistance tool for transmission lines design" IEE, 2017.
[6] "GUI-Based Corona and Field Analysis of Transmission lines" IEEE.
[7] "Hardware Implementation of transmission line and its study using MATLAB" IJERT.
[8] MATLAB GUI as assistance tool for transmission lines design DOI:http://doi.org/10.1109/CONESCAPAN.2017.8277594
[9] https://www.researchgate.net/publication/391482 6 68_Project_Report_Technical_Analysis_of_Transmission_Lines_Using_Matlab_Based_GUI