Report on Input Impedance App

Abstract

The ImpedancePlotterApp is a MATLAB application designed to facilitate an interactive and visual exploration of fundamental transmission line principles. The primary focus of the app is to elucidate the dynamic relationship between load impedance and input impedance. Through an intuitive user interface, the application empowers users to manipulate key parameters, observe real-time changes in transmission line behavior, and deepen their understanding of the underlying principles governing transmission lines.

Underlying Principles

Theoretical Input Impedance Formula:

The input impedance formula is given by:

$$Zi = Z_0 \frac{Z_L + jZ_0 \tan(\beta l)}{Z_0 + jZ_L \tan(\beta l)}$$

Where:

- Z_0: Characteristic Impedance
- Z_L: Load Impedance
- β: Phase Constant ($2\pi/\lambda$)
- l: Length of Transmission Line

Interactive Sliders:

The app incorporates interactive sliders (RLSlider and XLSlider) that dynamically alter load impedance. Users can manipulate these sliders in real-time, fostering hands-on exploration of transmission line behavior.

User-Defined Parameters:

Users have the flexibility to input parameters such as Ω, β, l, R_0, and X_0, allowing for a more customized exploration.

Key Results

Real Part of Input Impedance vs. Load Impedance (RealPartAxis):

This 3D plot illustrates how the real part of the input impedance (Zi_{real}) responds to changes in load impedance (Z_L). Adjustments to RL and XL sliders provide insights into the impact of load impedance variations on the transmission line.

Imaginary Part of Input Impedance vs. Load Impedance (ImagPartAxis):

The second 3D plot depicts the imaginary part of the input impedance (Zi_{imag}) in relation to load impedance (Z_L). Users can dynamically explore the effects of different RL and XL values on the imaginary part, enhancing understanding of impedance variations.

Real-Time Feedback on Load Impedance Settings (ValuesLabel):

The ValuesLabel dynamically displays current RL and XL values as sliders are adjusted. Real-time feedback aids users in comprehending the correlation between slider adjustments and resulting impedance changes.