# Parameters Visualization for Coaxial Cable, Parallel Plates, and Two Wires

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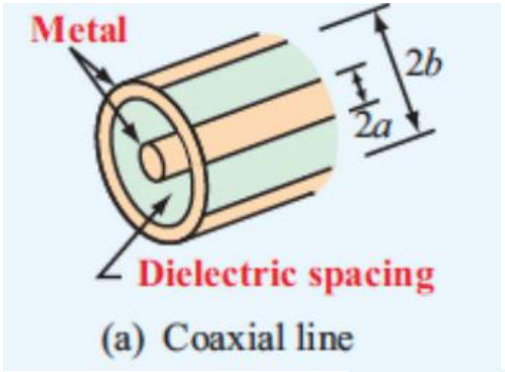


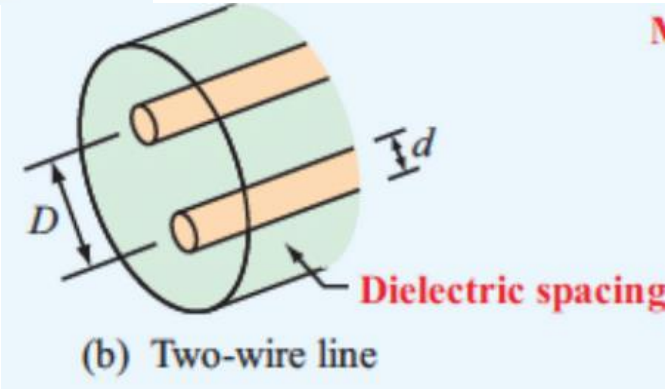


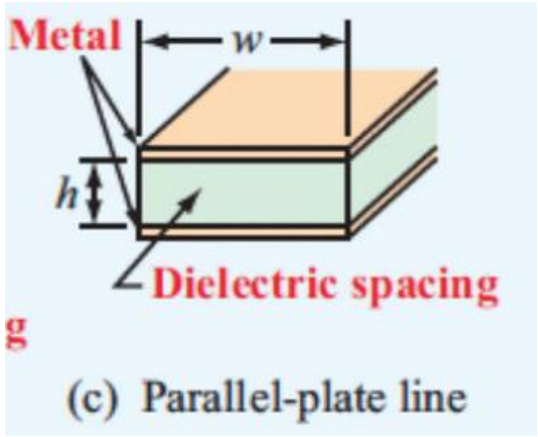


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[1] Fawwaz Tayssir Ulaby, Fundamentals of Applied Electromagnetics. Prentice Hall, 2007.

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# Outline

1. Introduction
2. Background Information
3. Methodology
4. Results
5. Conclusion

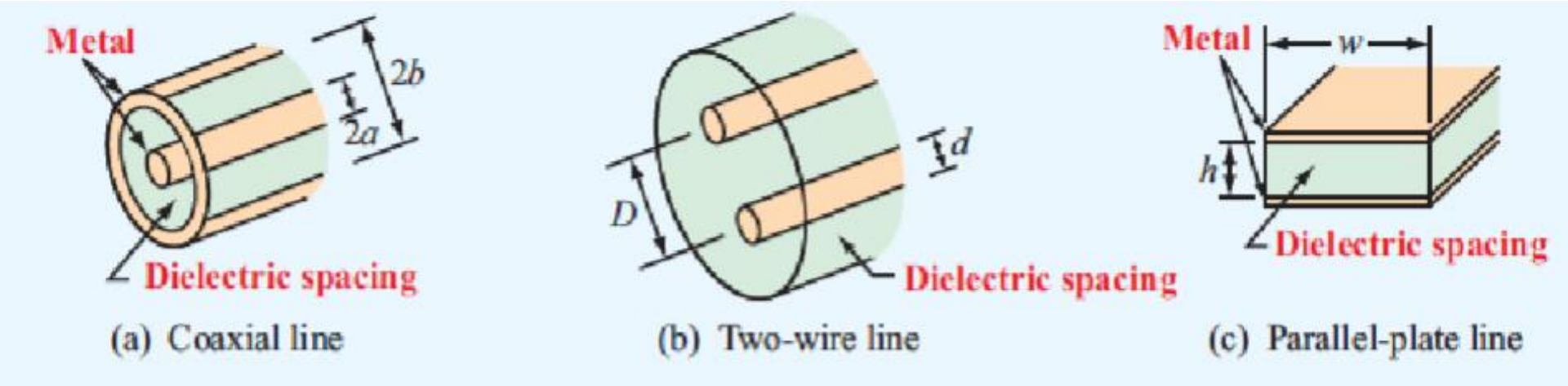
# Introduction

## Goal:

- Parameter analysis of coaxial cables, parallel plates, and two wire
  1. Allow users to dynamically visualize the frequency-dependent behavior of key transmission line characteristics:
  2. Resistance per unit length (R')
  3. Capacitance per unit length (C')
  4. Conductance per unit length (G')
  5. Inductance per unit length (L')

## Purpose:

- Create MATLAB apps designed as an interactive computational tool
  1. Aid students/ professionals in enhancing their understanding of electromagnetics through visualization

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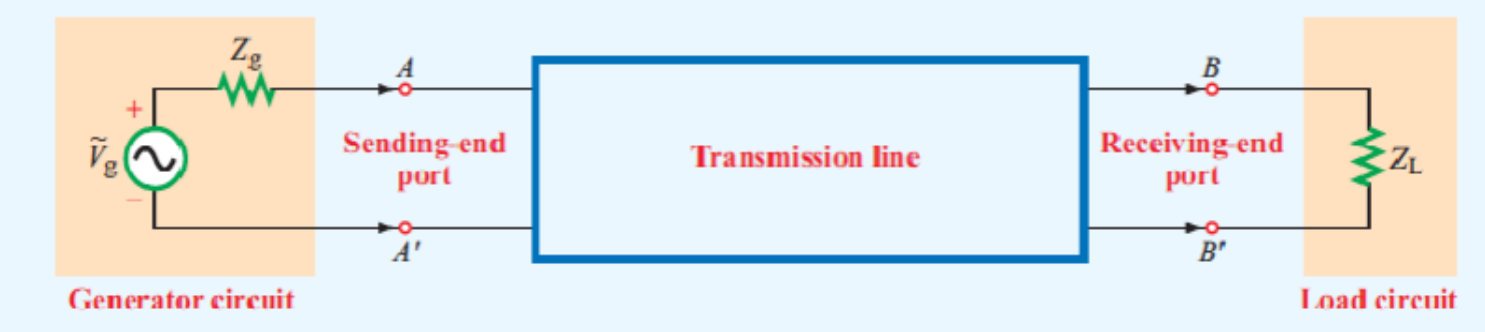
# Background: Electrical Properties of Transmission Lines

## What is a transmission line?

- Definition: A two-port network connecting a generator circuit at the sending end to a load at the receiving end

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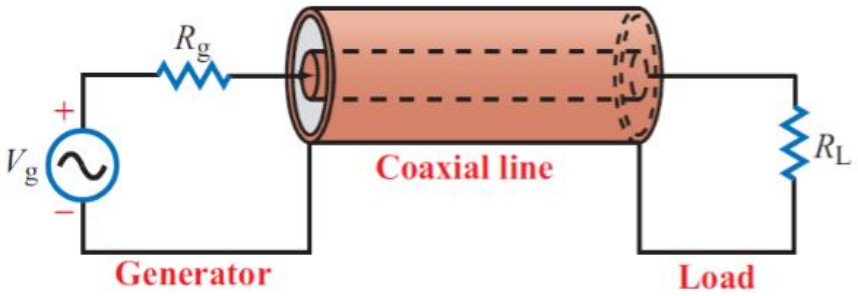
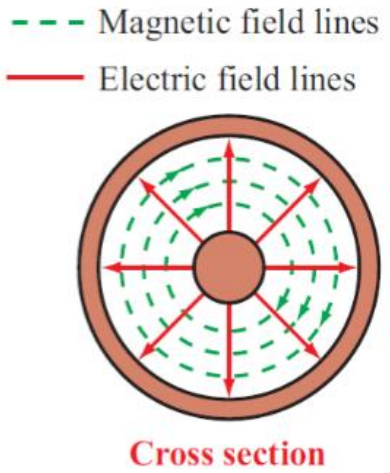
## TEM (Transverse Electromagnetic):

- Electric and magnetic fields are orthogonal to one another and the direction of propagation

## Coaxial Cable Example:

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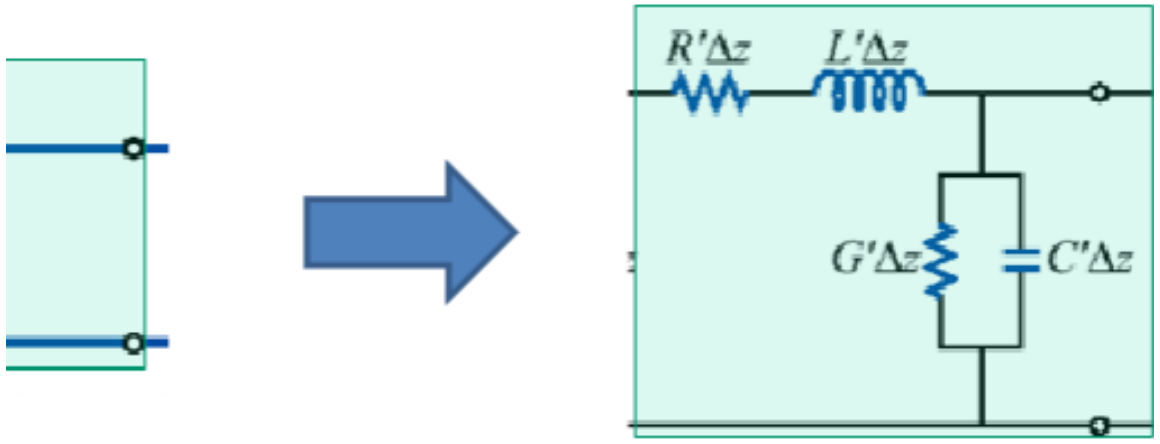
# Background: Passive Circuit Elements (R′,L′,C′,G′)

- **R′** = Combined Resistance of both conductors per unit length in (Ohm/m)
- **L′** = Combined Inductance of both conductors per unit length in (H/m)
- **G′** = Combined conductance of the insulation medium between the two conductors per unit length in (S/m)
- **C′** = Combined Capacitance of the two conductors per unit length in (F/m)

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## Parameter Equations:

| Parameter | Coaxial | Two-Wire | Parallel-Plate | Unit |
|---|---|---|---|---|
| $R'$ | $\frac{R_s}{2\pi}\left(\frac{1}{a}+\frac{1}{b}\right)$ | $\frac{2R_s}{\pi d}$ | $\frac{2R_s}{w}$ | Ω/m |
| $L'$ | $\frac{\mu}{2\pi}\ln(b/a)$ | $\frac{\mu}{\pi}\ln\left[(D/d)+\sqrt{(D/d)^2-1}\right]$ | $\frac{\mu h}{w}$ | H/m |
| $G'$ | $\frac{2\pi\sigma}{\ln(b/a)}$ | $\frac{\pi\sigma}{\ln\left[(D/d)+\sqrt{(D/d)^2-1}\right]}$ | $\frac{\sigma w}{h}$ | S/m |
| $C'$ | $\frac{2\pi\varepsilon}{\ln(b/a)}$ | $\frac{\pi\varepsilon}{\ln\left[(D/d)+\sqrt{(D/d)^2-1}\right]}$ | $\frac{\varepsilon w}{h}$ | F/m |

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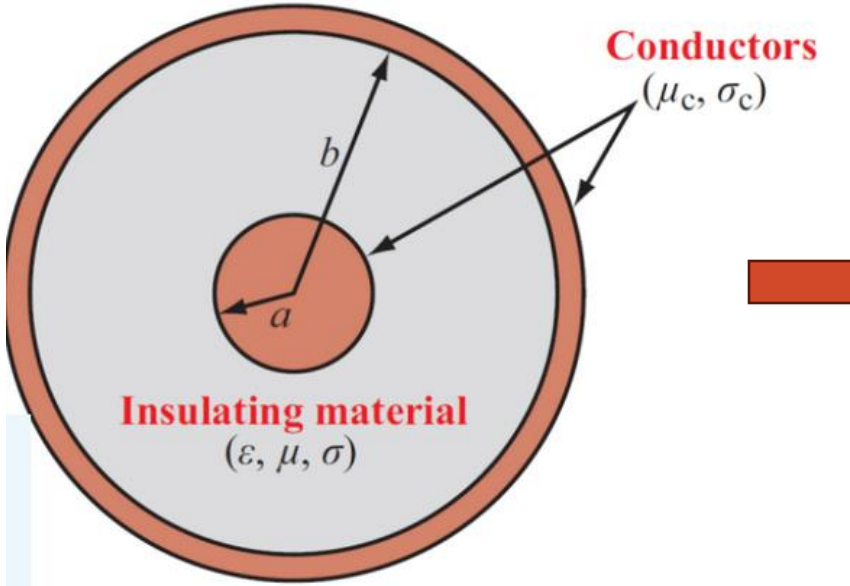
# Background: Transmission Line Parameters

- Pertinent consecutive parameters apply to all three lines [Coaxial, Two wire, Parallel Plates] and consist of two groups:
- (1) $\mu_c$ and $\sigma_c$
  - Magnetic permeability +electrical conductivity of the conductors
- (2) $\varepsilon$, $\mu$, and $\sigma$
  - Electrical permittivity, magnetic permeability, and electrical conductivity of the insulation material separating them

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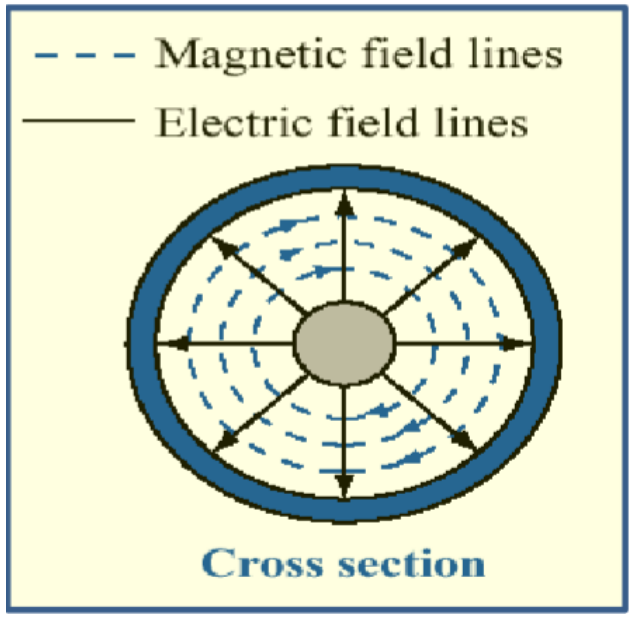


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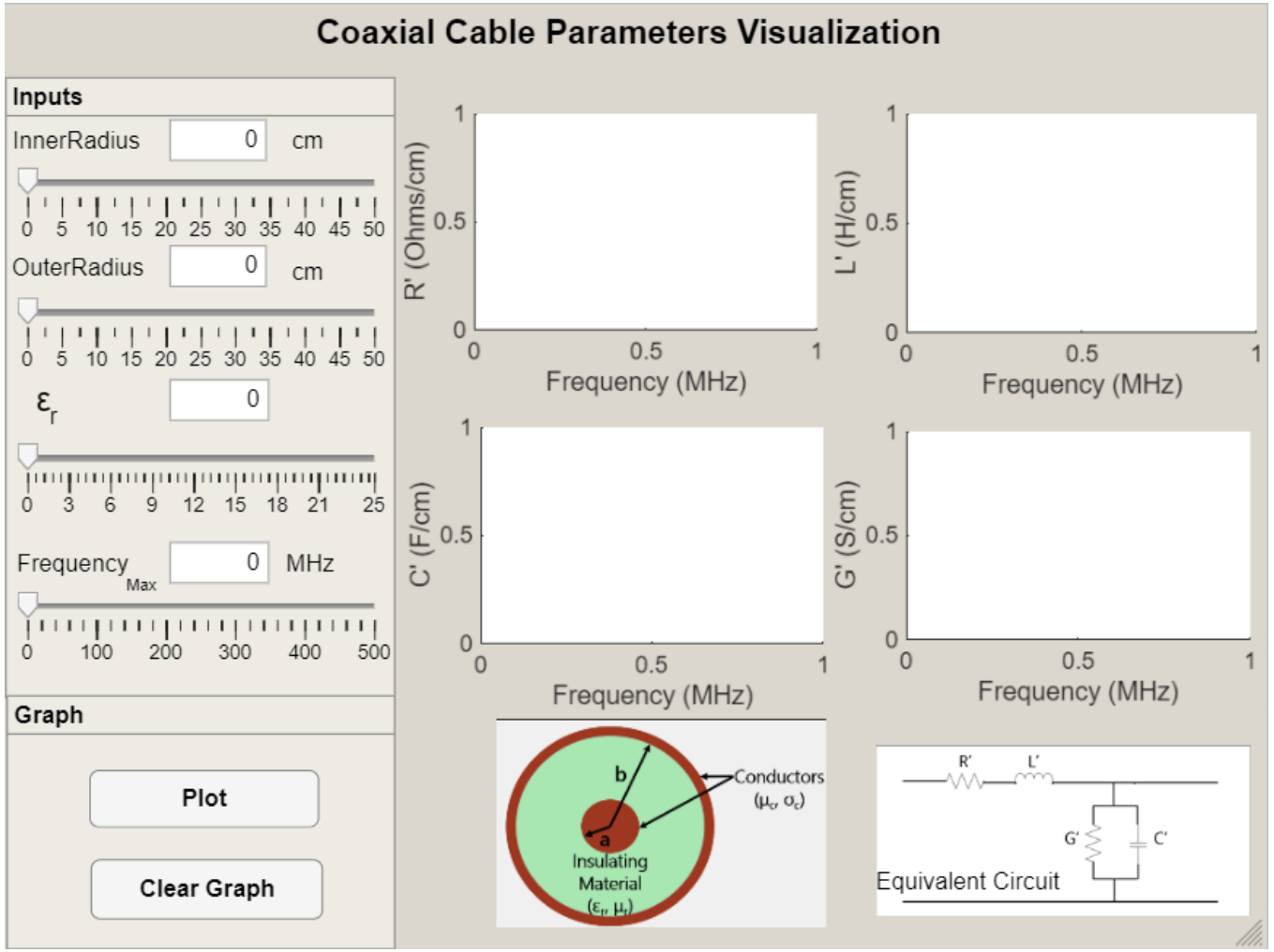
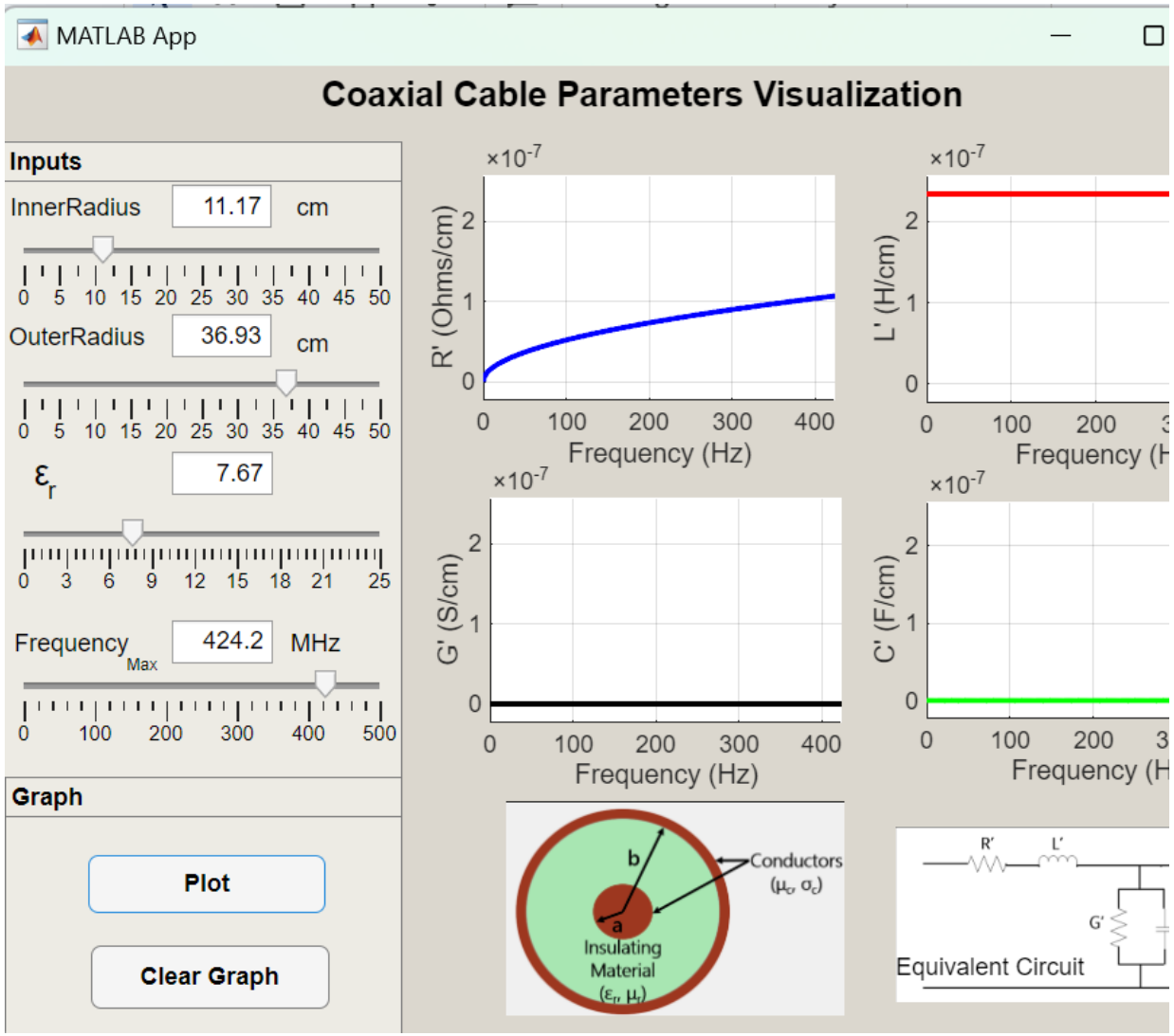
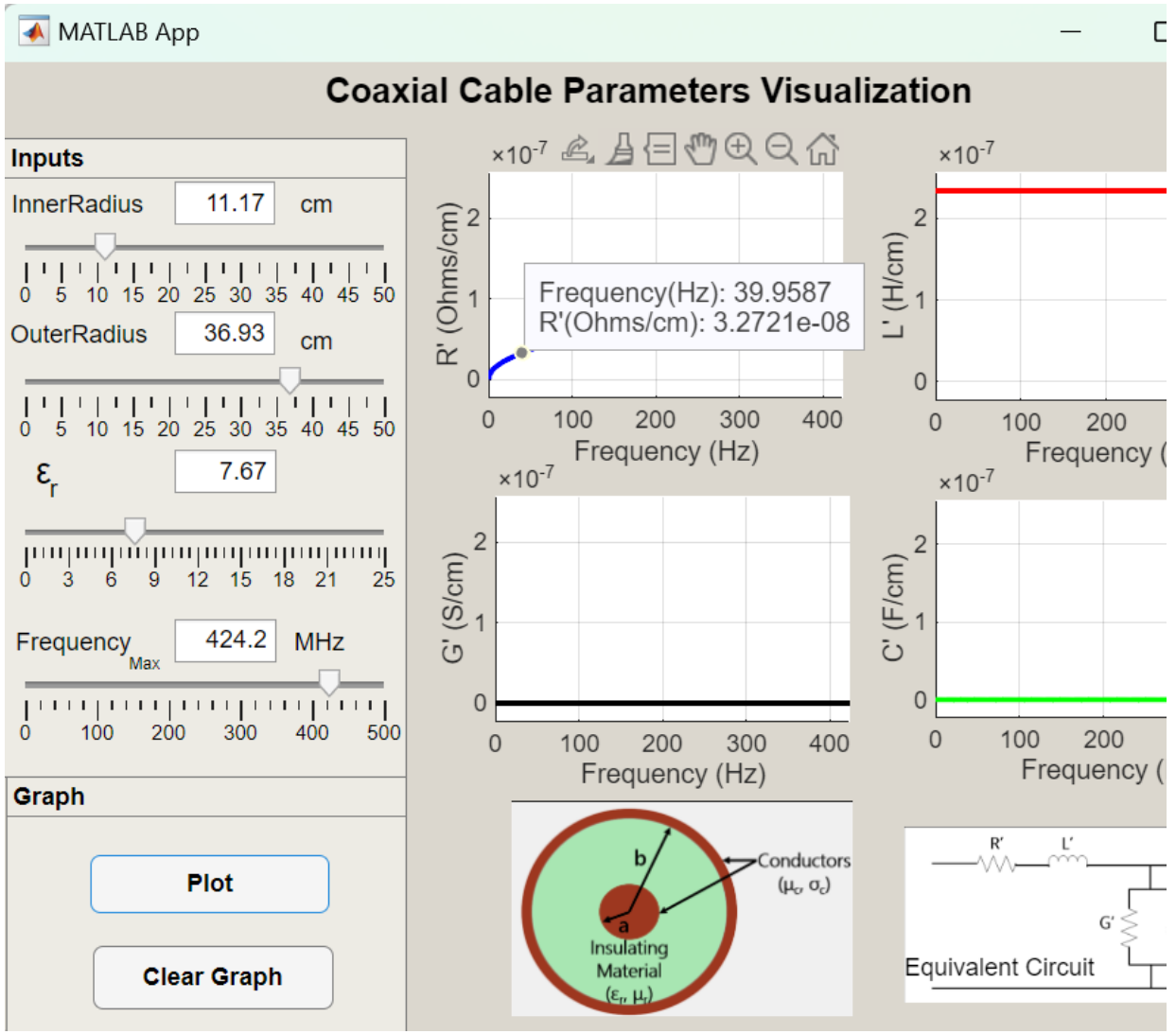
# Methodology & Results: Coaxial Cable

- Process:
  - Users input fundamental cable properties:
    - Inner radius
    - Outer radius
    - Permittivity
    - Frequency
    - Additional slider controls enabling real-time parameter adjustments
- App generates graphical plots of R', C', G', and L' versus frequency
  - Parameters evolve with frequency changes



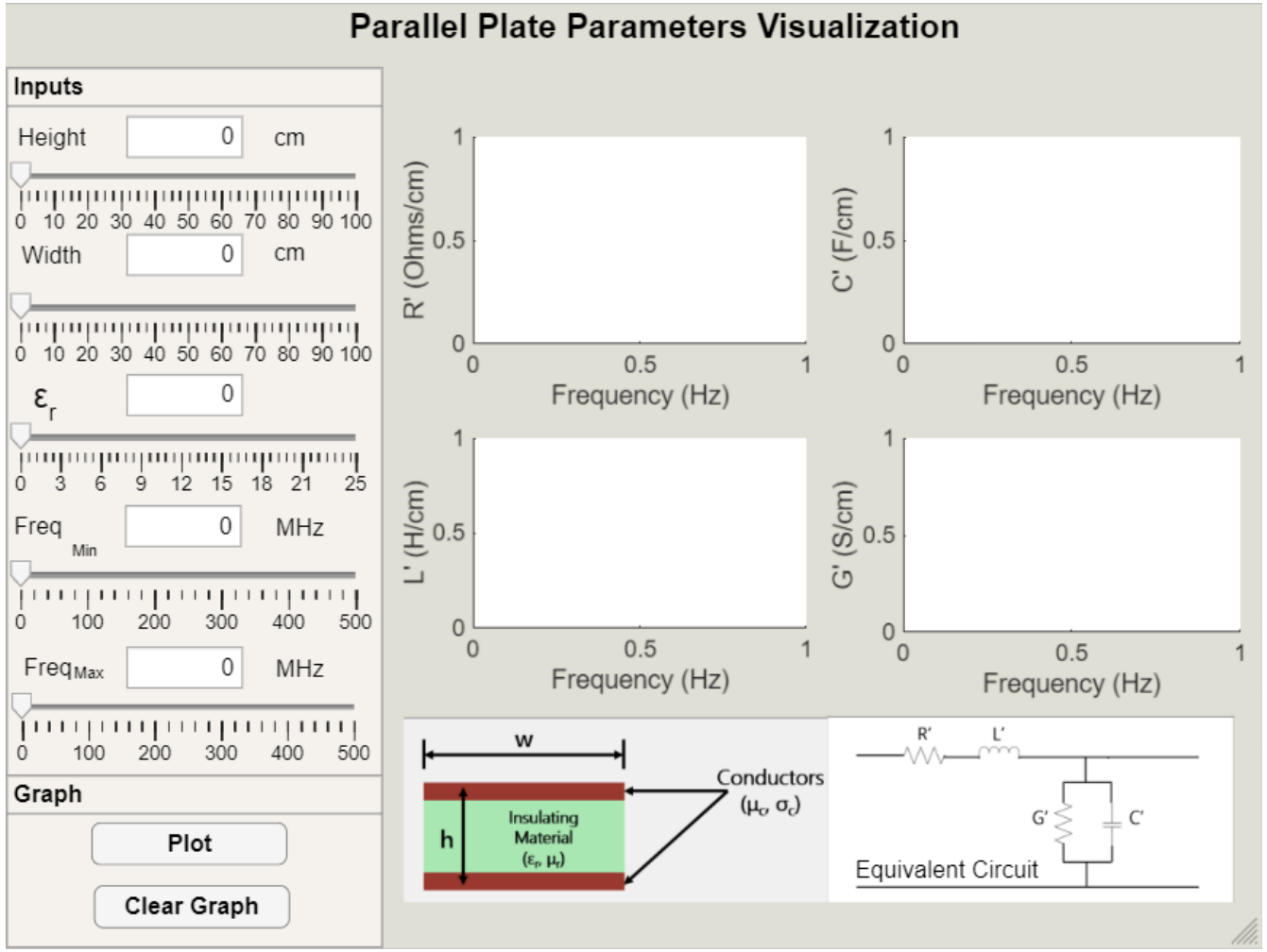
# Methodology & Results: Coaxial Cable Results



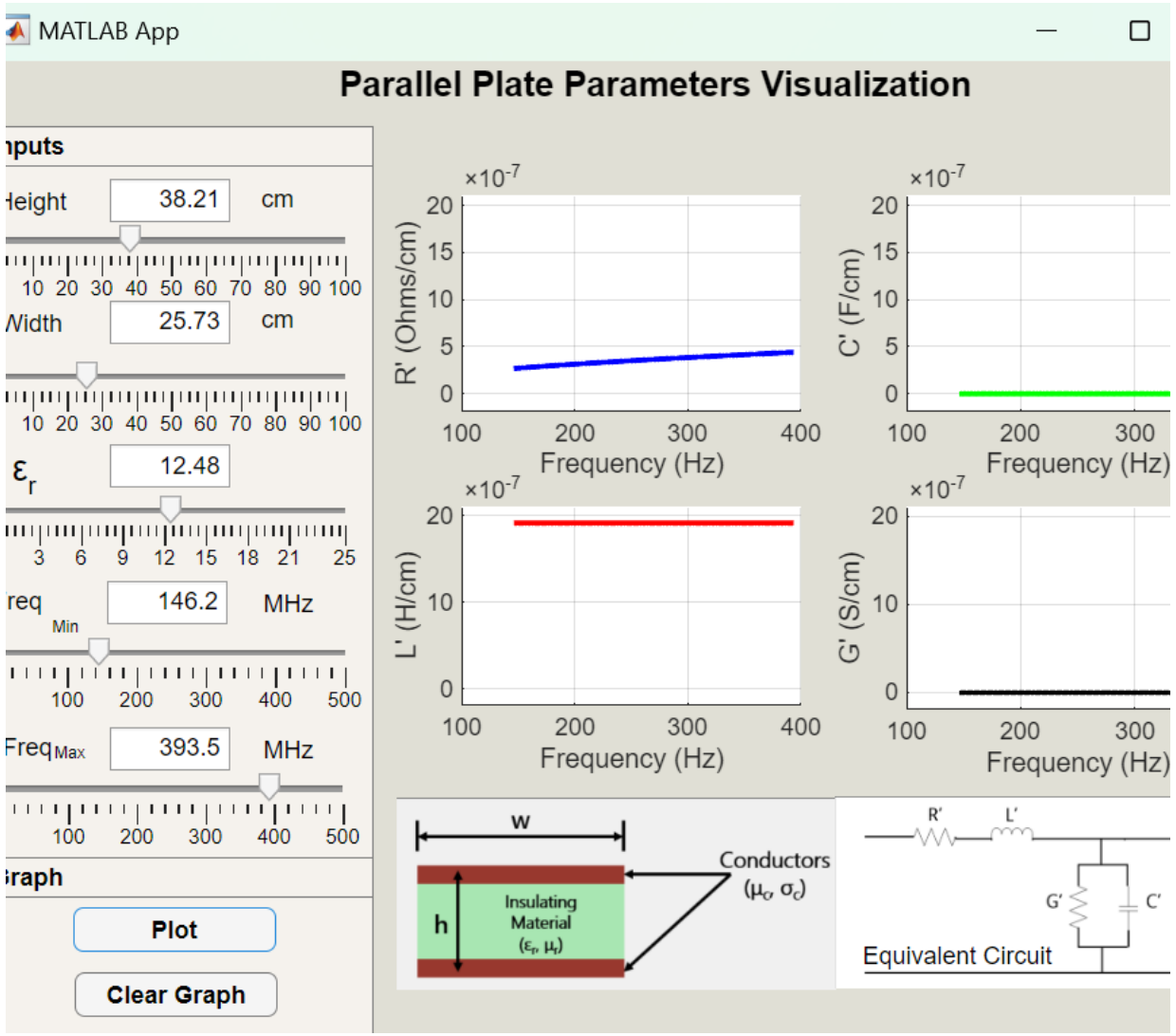



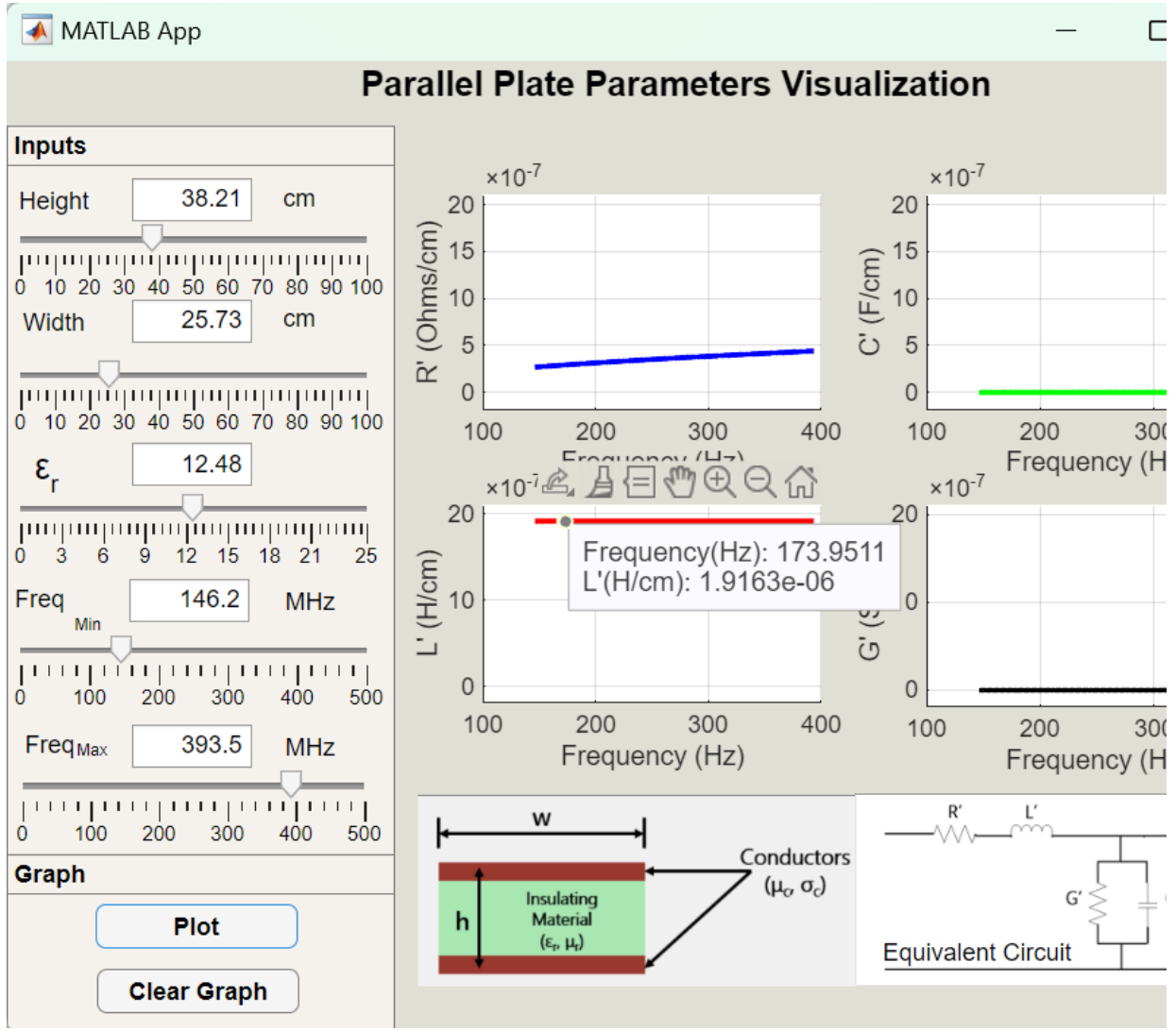
# Methodology & Results: Parallel Plate

- Process:
  - Users input fundamental cable properties:
    - Inner radius
    - Outer radius
    - Permittivity
    - Frequency
    - Additional slider controls enabling real-time parameter adjustments
- App generates graphical plots of R', C', G', and L' versus frequency
  - Parameters evolve with frequency changes



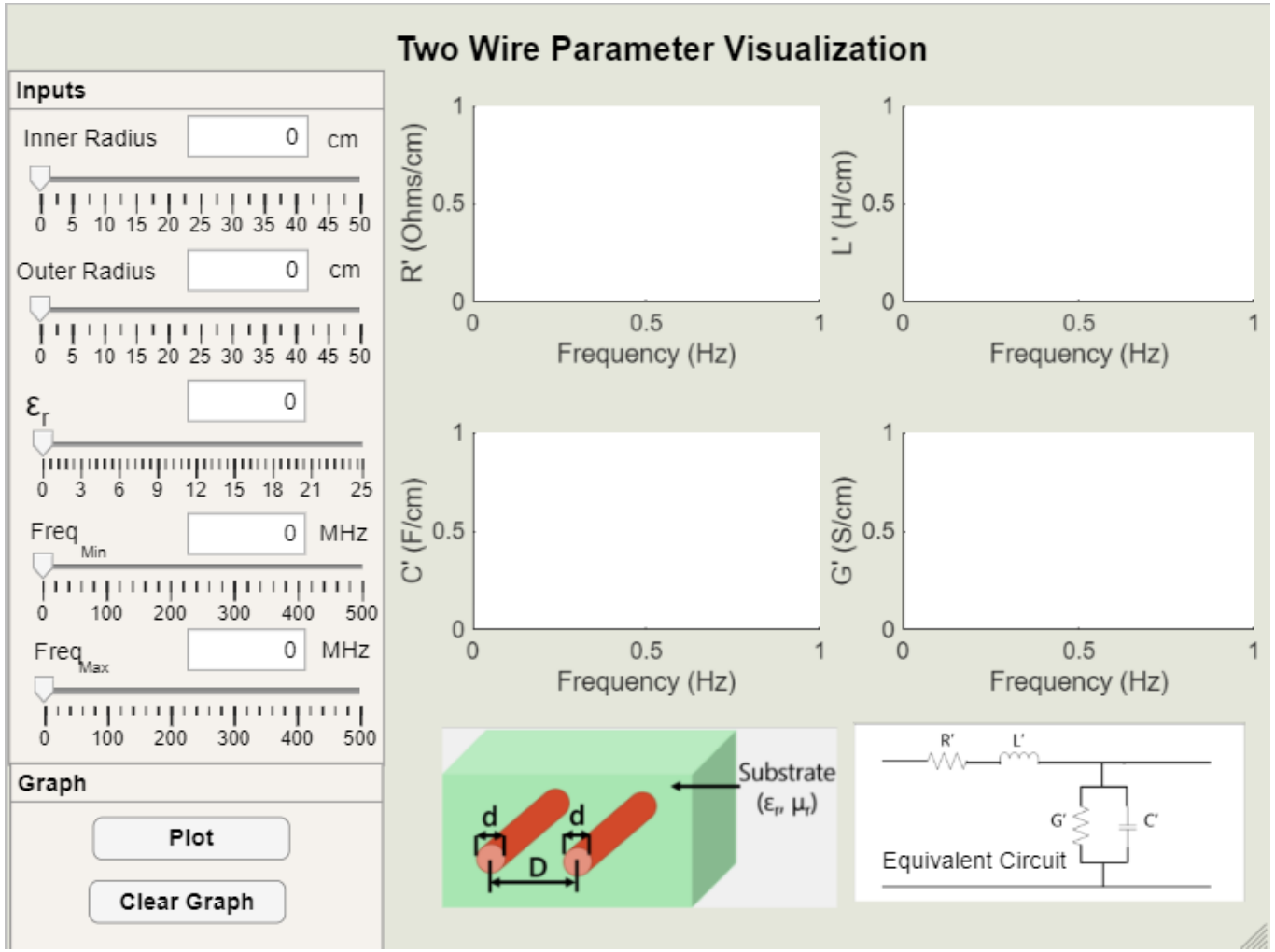
# Methodology & Results: Parallel Plate Results



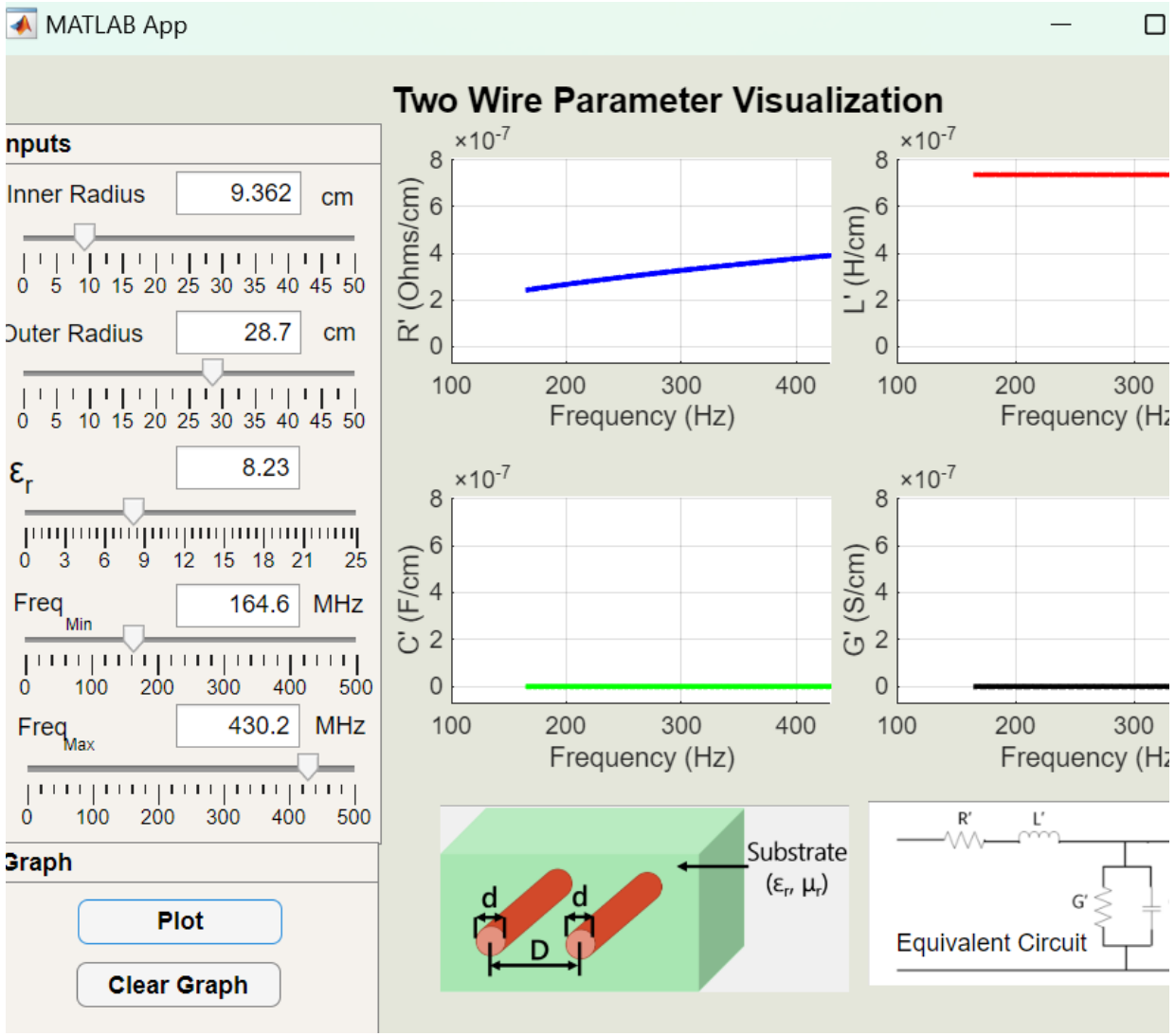



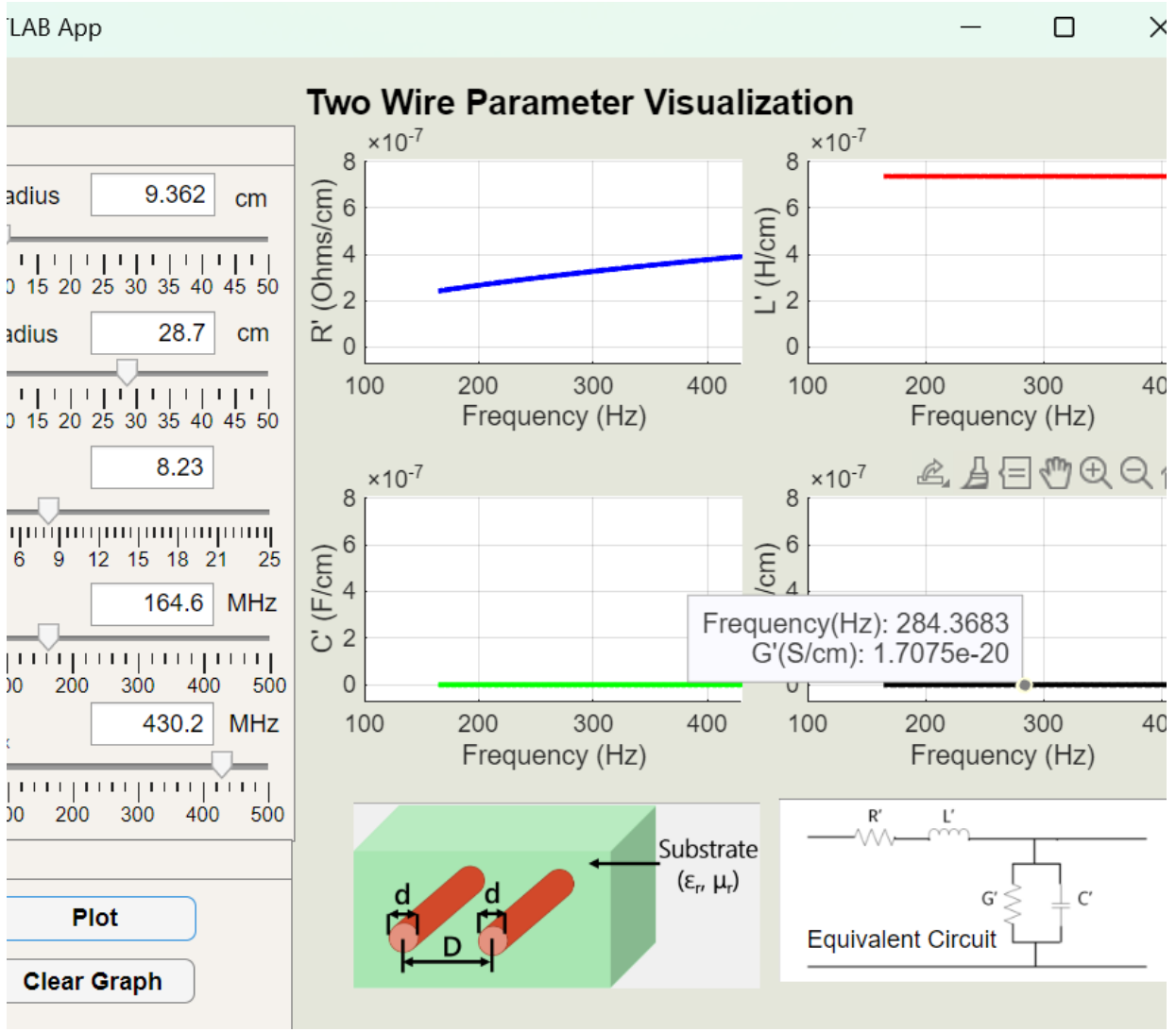
# Methodology & Results: Two Wire

- Process:
  - Users input fundamental cable properties:
    - Inner radius
    - Outer radius
    - Permittivity
    - Frequency
    - Additional slider controls enabling real-time parameter adjustments
- App generates graphical plots of R', C', G', and L' versus frequency
  - Parameters evolve with frequency changes



# Methodology & Results: Two Wire Results



# Conclusion

By bridging theoretical concepts with visual representation, these tools serve as an accessible learning resource, fostering deeper comprehension of coaxial cable, parallel plate waveguides, and two wire behavior in electromagnetic systems.

# Questions?

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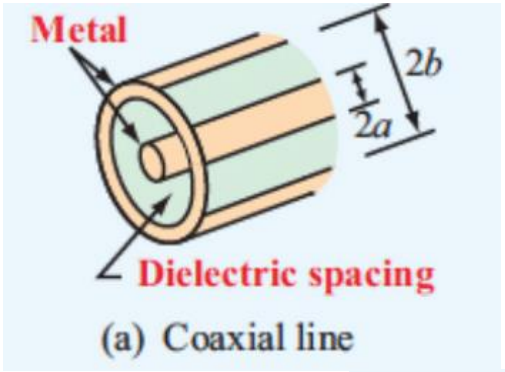


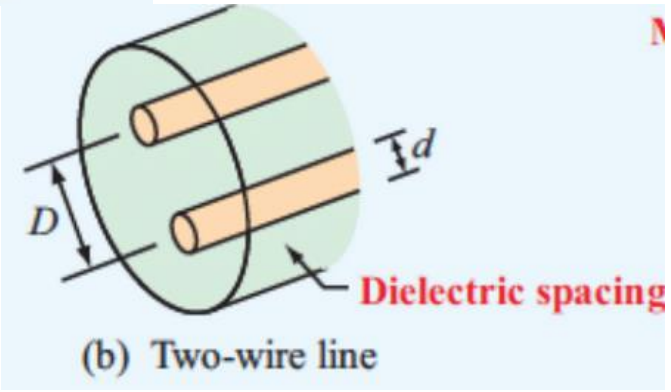


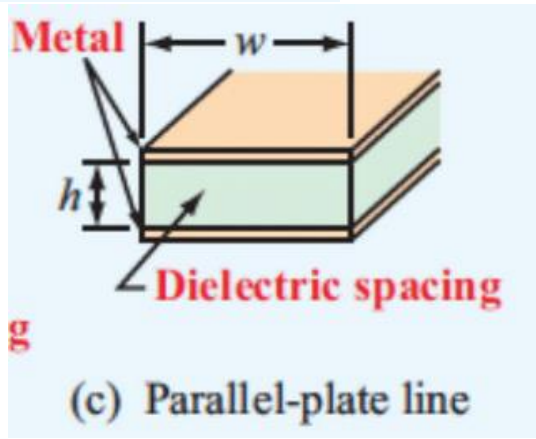


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