Transmission Lines

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- Transmission lines connect inputs to loads
  - l is the length of the transmission lines
  - If l is not much smaller than λ, we need detailed analysis
  - If l is comparable to λ, then we can not use the lumped parameter model
  - We can, however, partition the transmission lines into segments where $l << \lambda$, then we can apply Kirchoff's circuit laws to each subdivided segment
  - For an imperfect dielectric, there is some loss
  - Some per unit-length properties:
    1. Resistance per unit length: R' (ohm per meter)

$$\boxed{R = R'\Delta z}$$

    2. Inductance per unit length: L' (Henry per meter)

$$\boxed{L = L'\Delta z}$$

    3. Capacitance per unit length: C' (Farad per meter)

$$\boxed{C = C'\Delta z}$$

    4. Conductance per unit length: G' (Siemens per meter)

$$\boxed{G = G'\Delta z}$$

- Using this, we obtain the Helmholtz Equation:

$$\boxed{\frac{d^2\tilde{V}(z)}{dz^2} - \gamma^2\tilde{V}(z) = 0}$$

  - Where $\gamma = \sqrt{(j\omega C' + G')(j\omega L' + R')}$