

Transmission Line Modeling Example 2

$$j \equiv \sqrt{-1}$$

ABCD Parameters for line of any length

$$A_L(x) := \cosh(\gamma \cdot x) \quad B_L(x) := Z_c \cdot \sinh(\gamma \cdot x)$$

$$C_L(x) := \frac{\sinh(\gamma \cdot x)}{Z_c} \quad D_L(x) := \cosh(\gamma \cdot x)$$

ABCD Parameters approximation for line of length >50mi and <150mi

$$A_M(x) := 1 + \frac{(\gamma \cdot x)^2}{2} \quad B_M(x) := Z_c \cdot (\gamma \cdot x)$$

$$C_M(x) := \frac{\gamma \cdot x}{Z_c} \quad D_M(x) := 1 + \frac{(\gamma \cdot x)^2}{2}$$

ABCD Parameters approximation for line of length <50mi

$$A_S(x) := 1 \quad B_S(x) := z \cdot x$$

$$C_S(x) := 0 \quad D_S(x) := 1$$

Transmission Line Equations

$$VS(AA, BB) := AA \cdot VR + BB \cdot IR \quad IS(CC, DD) := CC \cdot VR + DD \cdot IR$$

Deviation of Calculated Voltages for Medium and Short Length Approximations

$$DLM(x) := \frac{|VS(A_L(x), B_L(x))| - |VS(A_M(x), B_M(x))|}{|VS(A_L(x), B_L(x))|}$$

$$DLS(x) := \frac{|VS(A_L(x), B_L(x))| - |VS(A_S(x), B_S(x))|}{|VS(A_L(x), B_L(x))|}$$

Transmission Line Data (From Example 1 in Session 9)

$$L \equiv 320 \quad (\text{Length of the 230kV Transmission Line in km})$$

$$z \equiv (0.050 + j \cdot 0.488) \quad (\text{Series Impedance of Transmission Line per km})$$

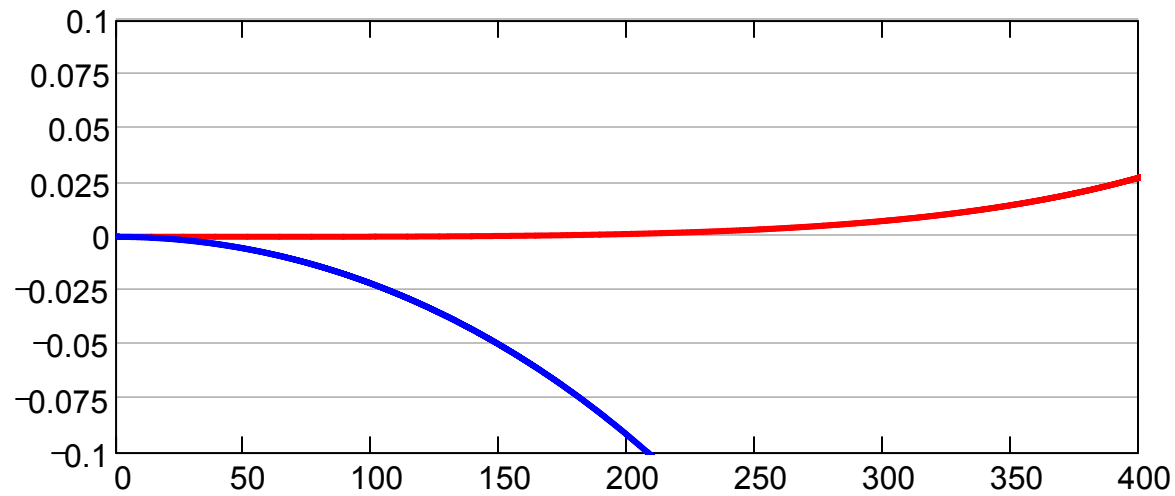
$$y \equiv j \cdot 3.371 \cdot 10^{-6} \quad (\text{Shunt Admittance of Transmission Line per km})$$

$$\gamma \equiv \sqrt{z \cdot y} \quad (\text{Attenuation Constant of Transmission Line per km})$$

$$Z_c \equiv \sqrt{\frac{z}{y}} \quad (\text{Characteristic Impedance of Transmission Line})$$

$$VR \equiv \frac{230}{\sqrt{3}} \cdot 1000 \quad IR \equiv 0.0e^{j \cdot 0\text{deg}}$$

x := 0, 0.1 .. 10L



Line Length in miles

- Long Line to Medium Line Deviation
- Long Line to Short Line Deviation

$$DLS(50 \cdot 1.609) = -0.534716 \%$$

$$DLM(150 \cdot 1.609) = 0.039580 \%$$

$$1\text{mi} = 1.60934 \text{ km}$$