Linii de transmisiune în mod TEM

I(z)

V(z)

z   z+dz

I   I+dI

V   V+dV

dz

I   Ldz   Rdz   I+dI

V   Cdz   Gdz   V+dV
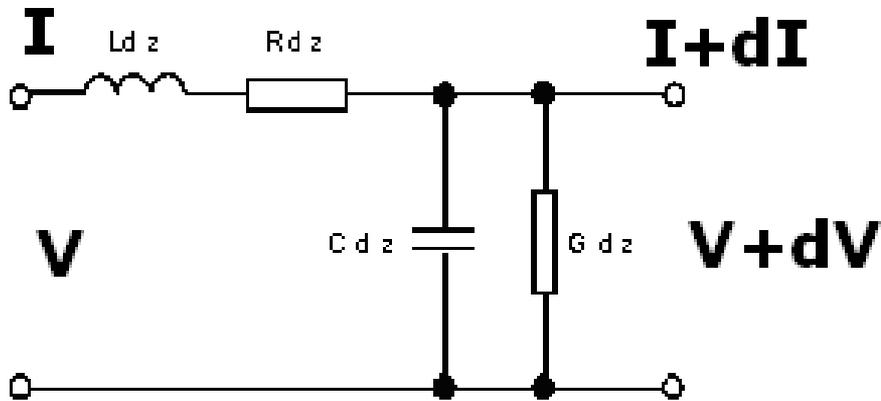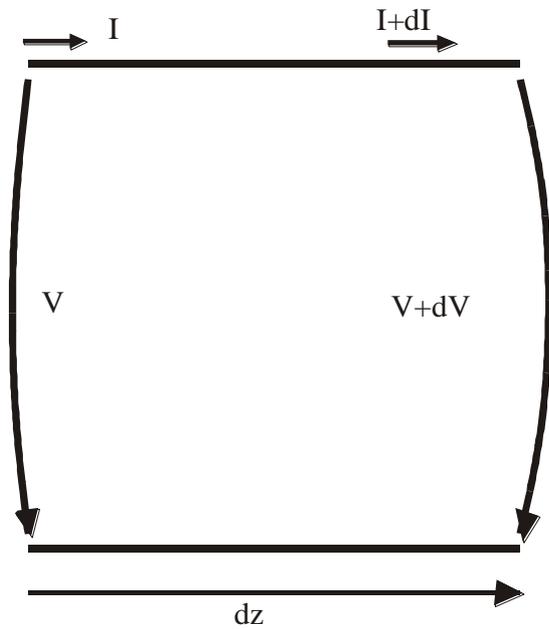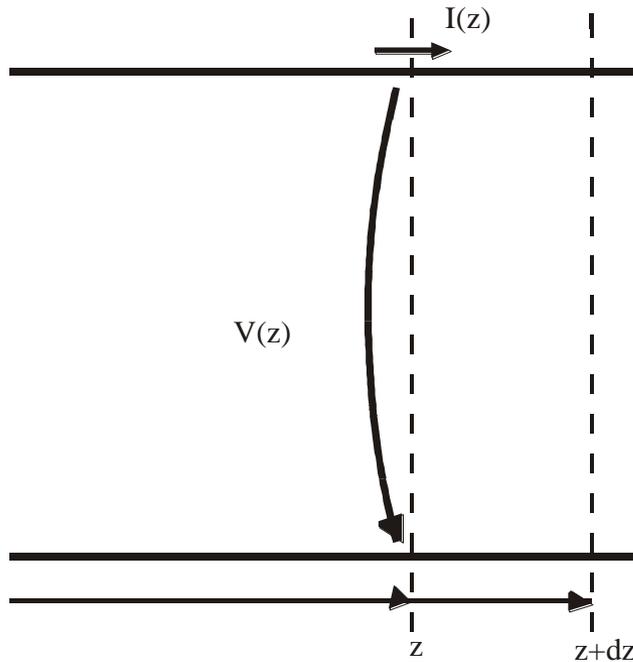
$$\begin{cases} -\dfrac{dV}{dz} = (R + j\omega L)I \\[2mm] -\dfrac{dI}{dz} = (G + j\omega C)V \end{cases}$$

$$\begin{cases} \dfrac{d^2V}{dz^2} - (R + j\omega L)(G + j\omega C)V = 0 \\ \qquad\qquad \text{sau} \\ \dfrac{d^2I}{dz^2} - (R + j\omega L)(G + j\omega C)I = 0 \end{cases} \qquad \begin{cases} V = \overset{+}{V}e^{-\gamma z} + \overset{-}{V}e^{+\gamma z} \\ I = \overset{+}{I}e^{-\gamma z} + \overset{-}{I}e^{+\gamma z} \end{cases}$$

$$\gamma = \alpha + j\beta = \sqrt{(R + j\omega L)(G + j\omega C)}$$

$$\frac{\overset{+}{V}}{\overset{+}{I}} = -\frac{\overset{-}{V}}{\overset{-}{I}} = \sqrt{\frac{R + j\omega L}{G + j\omega C}} = Z_c$$

$$\begin{cases} V = \overset{+}{V}e^{-\gamma z} + \overset{-}{V}e^{+\gamma z} \\ I = \overset{+}{I}e^{-\gamma z} + \overset{-}{I}e^{+\gamma z} \end{cases}$$

$\overset{+}{V}e^{-\gamma z} =$ **Unda de tensiune incidenta**

$\overset{-}{V}e^{+\gamma z} =$ **Unda de tensiune reflectata**

$\overset{+}{I}e^{-\gamma z} =$ **Unda de curent incidenta**

$\overset{-}{I}e^{+\gamma z} =$ **Unda de curent reflectata**

$$\frac{\overset{-}{V}e^{+\gamma z}}{\overset{+}{V}e^{-\gamma z}} = \Gamma_V$$

$$\frac{\overset{-}{I}e^{+\gamma z}}{\overset{+}{I}e^{-\gamma z}} = \Gamma_I$$

$$\Gamma_V = -\Gamma_I = \Gamma$$

Valorile tensiunii şi curentului în funcţie de condiţiile de terminaţie
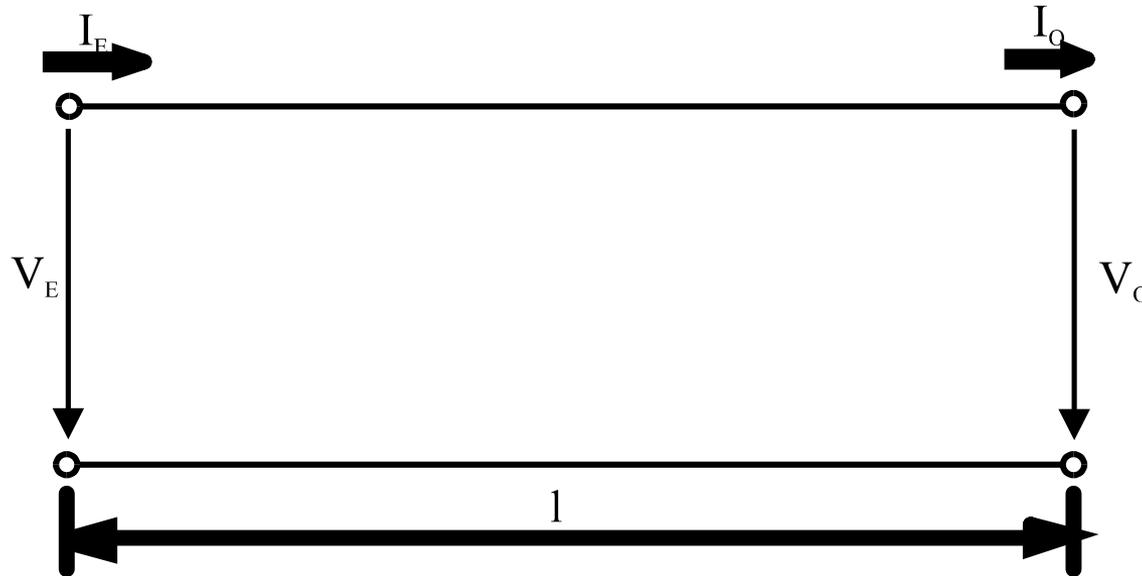
$$\begin{bmatrix} V_E \\ I_E \end{bmatrix} = \begin{bmatrix} ch(\gamma l) & Z_c sh(\gamma l) \\ \dfrac{sh(\gamma l)}{Z_c} & ch(\gamma l) \end{bmatrix} \cdot \begin{bmatrix} V_O \\ I_O \end{bmatrix} \Leftrightarrow \begin{bmatrix} V_O \\ I_O \end{bmatrix} = \begin{bmatrix} ch(\gamma l) & -Z_c sh(\gamma l) \\ -\dfrac{sh(\gamma l)}{Z_c} & ch(\gamma l) \end{bmatrix} \cdot \begin{bmatrix} V_E \\ I_E \end{bmatrix}$$

$$Z_E = Z_c \frac{Z_O + Z_c th(\gamma l)}{Z_c + Z_O th(\gamma l)}$$

Legătura dintre (V, I) şi tensiunile şi curenţii de la porţi

z in y, E in o
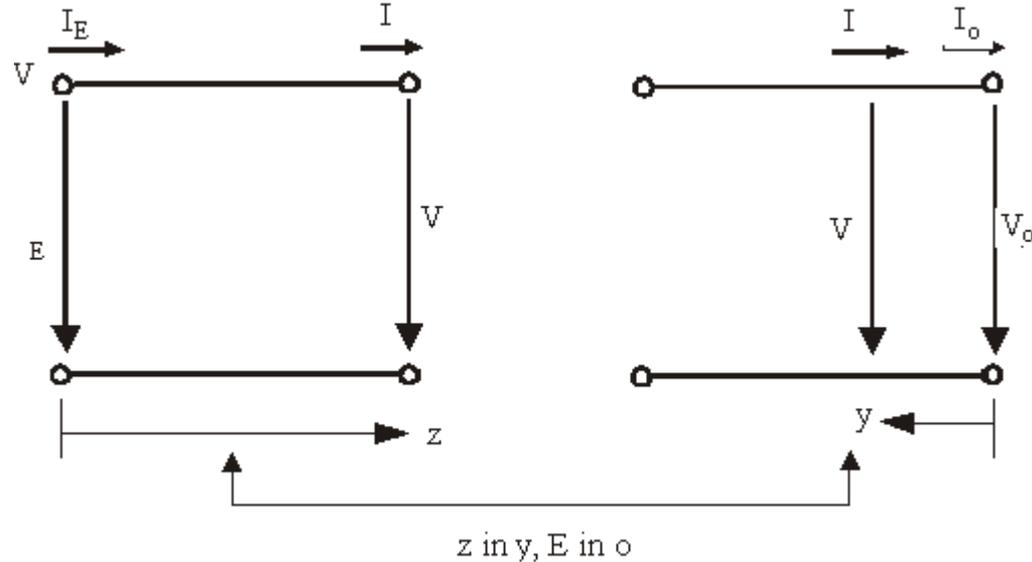
$$V = V_E ch(\gamma z) - Z_c I_E sh(\gamma z)$$

$$V = e^{-\gamma z}\frac{V_E + Z_c I_E}{2} + e^{\gamma z}\frac{V_E - Z_c I_E}{2}$$

$$\Gamma_E = \frac{Z_E - Z_c}{Z_E + Z_c}$$

$$V = \frac{V_E}{1+\Gamma_E}e^{-\gamma z}\left[1 + \Gamma_E e^{2\gamma z}\right]$$

$$I = \frac{I_E}{1-\Gamma_E}e^{-\gamma z}\left[1 - \Gamma_E e^{2\gamma z}\right]$$

$$V = V_O ch(\gamma y) + Z_c I_O sh(\gamma y)$$

$$V = e^{-\gamma y}\frac{V_O - Z_c I_O}{2} + e^{\gamma y}\frac{V_O + Z_c I_O}{2}$$

$$\Gamma_O = \frac{Z_O - Z_c}{Z_O + Z_c}$$

$$V = \frac{V_O}{1+\Gamma_O}e^{\gamma y}\left[1 + \Gamma_O e^{-2\gamma y}\right]$$

$$I = \frac{I_O}{1-\Gamma_O}e^{\gamma y}\left[1 - \Gamma_O e^{-2\gamma y}\right]$$