Note Title 9/10/2016

EE 610
09/15/16

Hua in AVW 1353 M@ 4pm email her 1st

$$v_{b_1} \cdot i_{b_1}^{a} + v_{b_2} \cdot i_{b_2}^{a} - v_{b_1}^{a} i_{b_1} - v_{b_2}^{a} i_{b_2} + v_{b-2}^{T} i_{b-2}^{a} - v_{b-2}^{aT} \cdot i_{b-2} = 0, \text{ take } \partial/\partial x$$

$$\frac{\partial v_{b_1}}{\partial x} \cdot i_{b_1}^{a} + v_{b_1} \cdot \underbrace{\frac{\partial i_{b_1}^{a}}{\partial x}}_{0} + \frac{\partial v_{b_2}}{\partial x} i_{b_2}^{a} + v_{b_2} \cdot \underbrace{\frac{\partial i_{b_2}^{a}}{\partial x}}_{0} - \underbrace{\frac{\partial v_{b_1}^{a}}{\partial x}}_{0} \cdot i_{b_1} - v_{b_1}^{a} \frac{\partial i_{b_1}}{\partial x} - \underbrace{\frac{\partial v_{b_2}^{a}}{\partial x}}_{0} i_{b_2} - v_{b_2}^{a} \cdot \frac{\partial i_{b_2}}{\partial x}$$

$$+ \frac{\partial v_{b-2}^{T}}{\partial x} \cdot i_{b-2}^{a} + v_{b-2}^{T} \underbrace{\frac{\partial i_{b-2}^{a}}{\partial x}}_{0} - \underbrace{\frac{\partial v_{b-2}^{aT}}{\partial x}}_{0} \cdot i_{b-2} - v_{b-2}^{aT} \cdot \frac{\partial i_{b-2}}{\partial x} = 0$$

all $\frac{\partial z^{a}}{\partial x} = 0$ as no changes in adjoint

choose $i_{b_2}^{a} = 1$ so $\frac{\partial v_{b_2}}{\partial x} \cdot i_{b_2}^{a} = \frac{\partial v_{b_2}}{\partial x} = \frac{\partial T(s)}{\partial x}$

$\frac{\partial v_{b_1}}{\partial x} = 0$ as a fixed $v$source; $\frac{\partial i_{b_2}}{\partial x} = 0$ as branch 2 is open

$$\cancel{\frac{\partial v_{b_1}}{\partial x}} \cdot i_{b_1}^{a} + \frac{\partial v_{b_2}}{\partial x} - v_{b_1}^{a} \frac{\partial i_{b_1}}{\partial x} - \cancel{v_{b_2}^{a} \frac{\partial i_{b_2}}{\partial x}} + \frac{\partial v_{b-2}^{T}}{\partial x} \cdot i_{b-2}^{a} - v_{b-2}^{aT} \frac{\partial i_{b-2}}{\partial x} = 0$$

assume $i_{b-2} = Y_{b-2 \times b-2} \, v_{b-2}$, $i_{b-2}^{a} = Y_{b-2 \times b-2}^{a} \, v_{b-2}^{a}$

$$\frac{\partial T(a)}{\partial x} = v_{b_1}^{a} \frac{\partial i_{b_1}}{\partial x} + \frac{\partial v_{b-2}^{T}}{\partial x} \cdot Y_{b-2 \times b-2}^{a} \cdot v_{b-2}^{a} - v_{b-2}^{aT} \cdot \left[\frac{\partial Y_{b-2 \times b-2}}{\partial x} v_{b-2} + Y_{b-2 \times b-2} \cdot \frac{\partial v_{b-2}}{\partial x} \right]$$

$$= v_{b_1}^{a} \cdot \frac{\partial i_{b_1}}{\partial x} + \frac{\partial v_{b-2}^{T}}{\partial x} \cdot Y_{b-2 \times b-2}^{a} \, v_{b-2}^{a} \qquad = 0$$

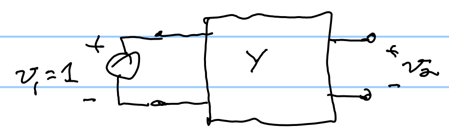
$$- v_{b-2}^{T} \cdot \frac{\partial Y_{b-2 \times b-2}^{T}}{\partial x} \cdot v_{b-2}^{a} - \frac{\partial v_{b-2}^{T}}{\partial x} Y_{b-2 \times b-2}^{T} \cdot v_{b-2}^{a}$$

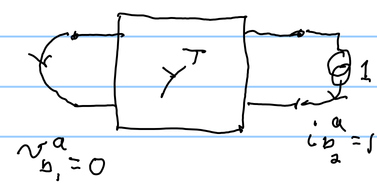
$$= v_{b_1}^{a} \frac{\partial i_{b_1}}{\partial x} + \frac{\partial v_{b-2}^{T}}{\partial x} \underbrace{\left[Y_{b-2 \times b-2}^{a} - Y_{b-2 \times b-2}^{T} \right]}_{\text{choose } Y_{b-2 \times b-2}^{a} = Y_{b-2 \times b-2}^{T}} v_{b-2}^{a} - v_{b-2}^{aT} \cdot \frac{\partial Y_{b-2 \times b-2}}{\partial x} v_{b-2}$$

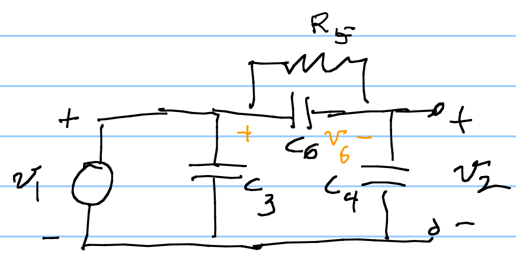
force
= 0 by
a short

$$\frac{\partial T(a)}{\partial x} = \frac{\partial \, v_2 / v_1}{\partial x} = - v_{b-2}^{aT} \frac{\partial Y_{b-2 \times b-2}}{\partial x} \cdot v_{b-2}$$

circuits



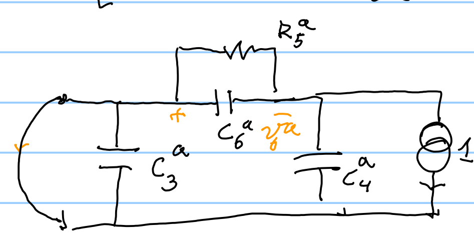




choose $x = C_6$

$$Y_{b-2 \times b-2} = \begin{bmatrix} sC_3 & 0 & 0 & 0 \\ 0 & sC_4 & 0 & 0 \\ 0 & 0 & G_5 & 0 \\ 0 & 0 & 0 & sC_6 \end{bmatrix}$$

$$\frac{\partial Y_{b-2 \times b-2}}{\partial C_6} = \begin{bmatrix} 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & s \end{bmatrix}$$



$\partial T / \partial C_6 = - v_6^a \cdot s \cdot v_6$

$$S_{c_6}^{v_2/v_1} = \frac{\partial T/\partial c_6}{T/c_6}$$

$$T(\alpha) = |T(\alpha)| e^{j\angle T(\alpha)} \; ; \; \frac{dT(\alpha)}{dx} = \frac{d|T(\alpha)|}{dx} \cdot e^{\angle T(\alpha)} + |T(\alpha)| e^{j\angle T(\alpha)} \cdot \frac{d\angle T(\alpha)}{dx}$$

$$S_x^T = \frac{\frac{\partial |T(\alpha)|}{\partial x} e^{j\angle T(\alpha)} + |T(\alpha)| e^{j\angle T} \cdot d\angle T(\alpha)/dx}{|T(\alpha)| e^{j\angle T(\alpha)} / x} = S_x^{|T(\alpha)|} + x \, d\angle T(\alpha)/dx$$

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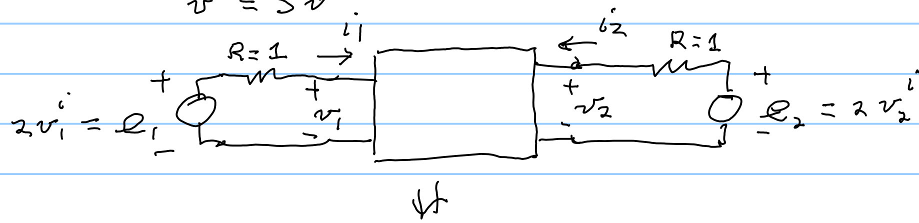
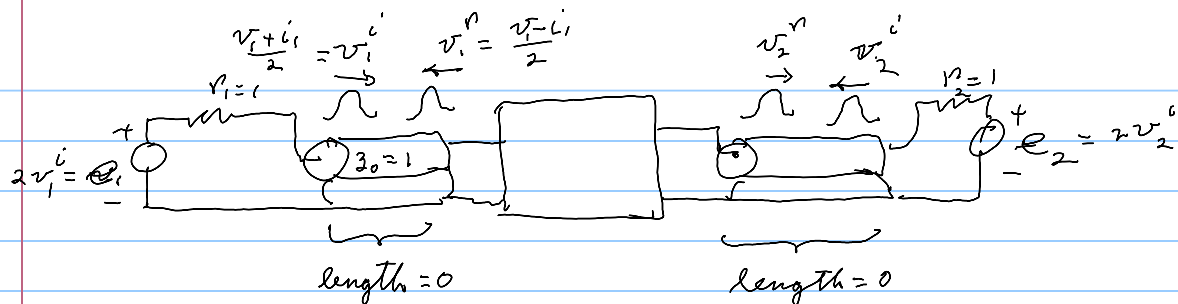
Scattering matrix $\quad 2v^i = v + i$

$z_0 \Rightarrow$ normalized to 1

$$2v^r = v - i$$

$$v^r = S v^i$$





$$\left.\begin{aligned} 2v^i &= v + i \\ 2v^r &= v - i \end{aligned}\right\} \text{solve for } v \text{ \& } i \qquad \begin{aligned} 2v &= 2v^i + 2v^r \Rightarrow v = v^i + v^r \\ 2i &= 2v^i - 2v^r \Rightarrow i = v^i - v^r \end{aligned}$$

$$Av = Bi \qquad i = B^{-1}Av \Rightarrow Y = B^{-1}A$$

$$A(v^i + v^r) = B(v^i - v^r) \Rightarrow (A+B)v^r = (B-A)v^i$$

$$v^r = Sv^i \Rightarrow S = (A+B)^{-1}(B-A)$$

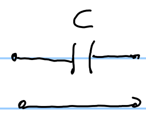
if B^{-1} exists

$$= (B[B^{-1}A + 1])^{-1}(B[1 - B^{-1}A])$$

$$= [B^{-1}A + 1]^{-1}B^{-1} \cdot B[1 - B^{-1}A]$$

$$= [Y + 1]^{-1}[1 - Y]$$

Eg:



$$\Rightarrow \begin{bmatrix} \alpha C & -\alpha C \\ -\alpha C & \alpha C \end{bmatrix}$$