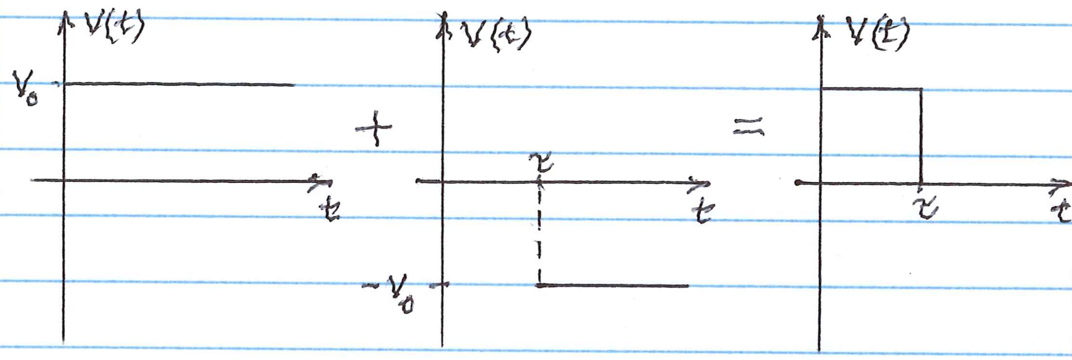
EE331 - LECTURE # 14 FEB. 19, 2020

transients on a line

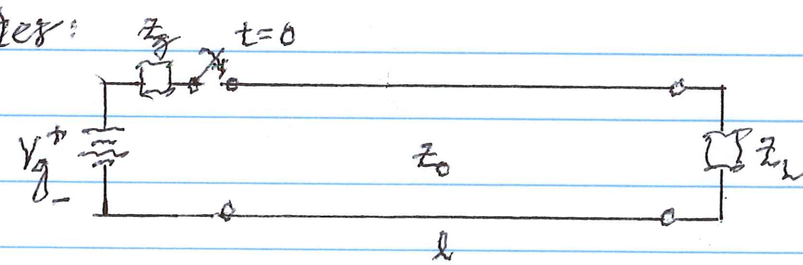
consider the sum of two step funcs:



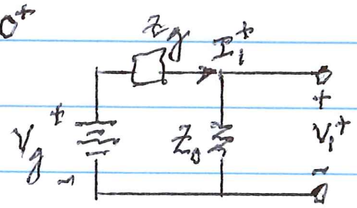
these two step functions offset by time τ s. result in a single pulse

can analyze what happens on a TL to a single step func & combine results to get complete behavior of pulse.

consider:



at $t = 0^+$



- Z_0 real for lossless line
- wave takes finite amt of time to travel to load

$$V_1^+ = \frac{Z_0}{Z_g + Z_0} V_g \; [V] \qquad I_1^+ = \frac{V_g}{Z_g + Z_0} \; [A]$$

wave travels down TL & reaches load at $t = T$s.

$$T = l/u \quad [s]$$

at load, voltage (or curr) is sum of inc & refl voltage (or curr). thus,

@ $t = T$ $\quad V_L = V_1^+ + \Gamma_L V_1^+ = \underset{\rightarrow}{V_1^+} + \underset{\leftarrow}{V_1^-}$ $\quad \longrightarrow T$

T seconds later refl voltage V_1^- hits generator. voltage at gen is sum of initial voltages (i.e., we haven't turned off the generator), voltage reflected by load, <u>and</u> voltage reflected by mismatch of Z_g & Z_0 [Γ_g]. thus,

@ $t = 2T$ $\quad V_g = V_1^+ + V_1^- + \Gamma_g V_1^- = V_1^+ + \Gamma_L V_1^+ + \Gamma_g \Gamma_L V_1^+$

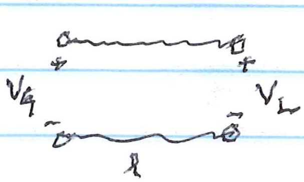
$$= \underset{\rightarrow}{V_1^+} + \underset{\leftarrow}{V_1^-} + \underset{\rightarrow}{V_2^+}$$

$\longrightarrow T$

$2T \longleftarrow$

$$\Gamma_g = \frac{Z_g - Z_0}{Z_g + Z_0} \qquad \Gamma_L = \frac{Z_L - Z_0}{Z_L + Z_0}$$

$V_g \neq V_g$



similarly,

@ $t = 3T$ $\quad V_L = V_1^+ + \Gamma_L V_1^+ + \Gamma_g \Gamma_L V_1^+ + \Gamma_L \Gamma_g \Gamma_L V_1^+$

$$= \underset{\rightarrow}{V_1^+} + \underset{\leftarrow}{V_1^-} + \underset{\rightarrow}{V_2^+} + \underset{\leftarrow}{V_2^-} \qquad \begin{matrix} \longrightarrow T \\ 2T \longleftarrow \\ \longrightarrow 3T \end{matrix}$$

& so on. at steady state:

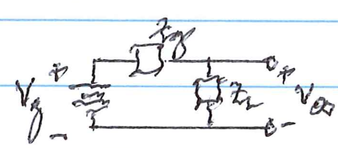
$$V_\infty = V_1^+ + V_1^- + V_2^+ + V_2^- + V_3^+ + V_3^- + V_4^+ + \cdots$$
$$= V_1^+(1 + \Gamma_L + \Gamma_g\Gamma_L + \Gamma_L\Gamma_g\Gamma_L + \Gamma_g\Gamma_L\Gamma_g\Gamma_L + \cdots)$$
= geometric series

V_∞ can be written as:

$$V_\infty = V_1^+\left(\frac{1+\Gamma_L}{1-\Gamma_g\Gamma_L}\right)$$

use eqs for V_1^+, Γ_L, & Γ_g in V_∞, do algebra, & end up with

$$V_\infty = \frac{Z_L}{Z_g + Z_L} V_g \quad , \quad I_\infty = \frac{V_g}{Z_g + Z_L}$$



at steady state get exactly what you'd get w/o a TL.

use bounce diagram to find behavior of transient before steady state is reached.