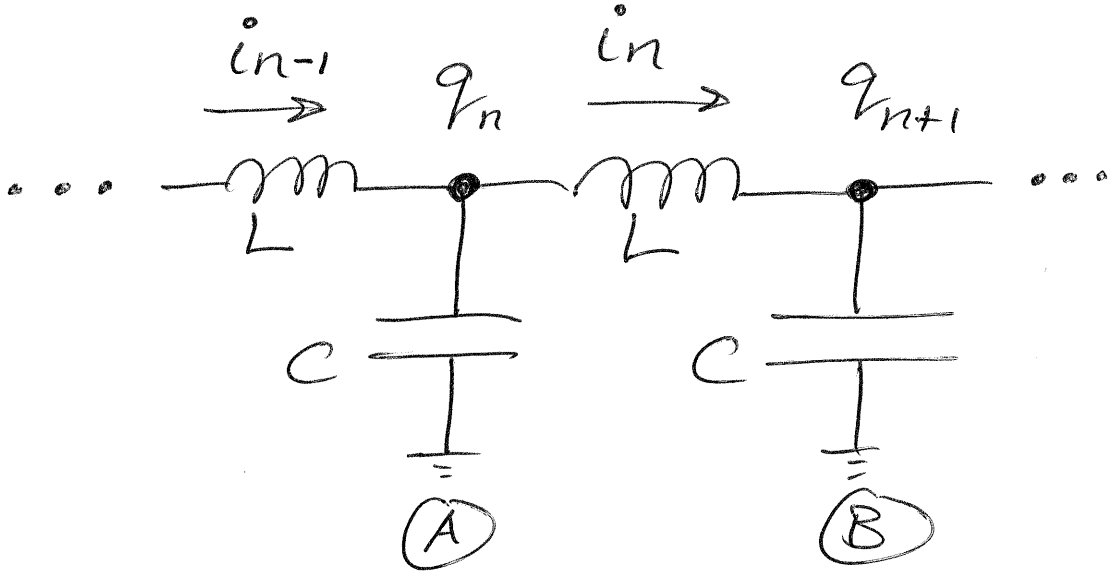
Lecture 6



Kirchhoff junction (charge conserv.):

$$\dot{q}_n = i_{n-1} - i_n \qquad \text{(Eq. 1)}$$

Kirchhoff loop (energy conserv.):

$$V_{AB} = 0 = \frac{q_n}{C} - L\frac{di_n}{dt} - \frac{q_{n+1}}{C}$$

$$\Rightarrow \frac{di_n}{dt} = \frac{1}{LC}(q_n - q_{n+1}) \qquad \text{(Eq. 2)}$$

$\frac{d}{dt}$(Eq. 2) :

$$\frac{d^2 i_n}{dt^2} = \frac{1}{LC}\left(\dot{q}_n - \dot{q}_{n+1}\right)$$

substitute from Eq. 1 :

$$\frac{d^2 i_n}{dt^2} = \frac{1}{LC}\left(i_{n-1} - i_n - i_n + i_{n+1}\right)$$

$$= \frac{l^2}{LC}\left(i_{n-1} - 2i_n + i_{n+1}\right)/l^2$$

$$\simeq \frac{1}{\tilde{L}\tilde{C}} \frac{\partial^2 i}{\partial x^2}$$

$i_n(t) \longrightarrow i(x,t)$

$$\frac{\partial^2 i}{\partial t^2} = \frac{1}{\tilde{L}\tilde{C}} \frac{\partial^2 i}{\partial x^2}$$

$\longleftarrow v_c^2 \swarrow$

(slinky wave Eq.) = (co-ax wave Eq.)

coincidence ?

general principles :

- locality (in time & space)
- linearity (of amplitude)
- symmetry of space-time
  - reversal of coord's.
  - rotations / boosts
  - translations
- symmetry of wave amplitude

Identify principles violated (6.4)
by additional terms:

$$\frac{\partial^2 \psi}{\partial t^2} + A\,\psi(x, t-\tau) + B\left(\frac{\partial \psi}{\partial t}\right)^2$$

$$+ C\,\frac{\partial \psi}{\partial t} + (D\cos\omega t)\,\psi$$

$$+ E\,\psi + \cdots = v^2\,\frac{\partial^2 \psi}{\partial x^2} + \cdots$$