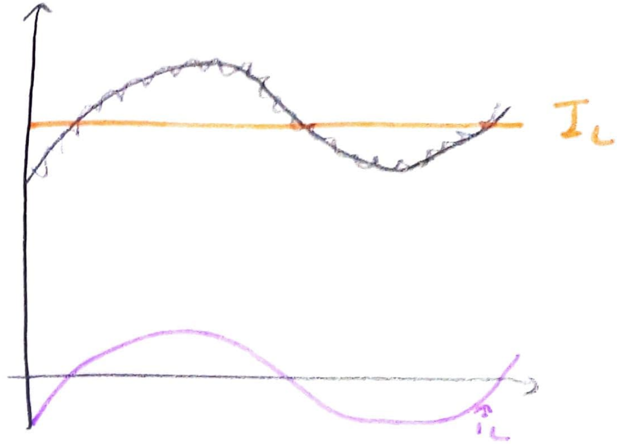
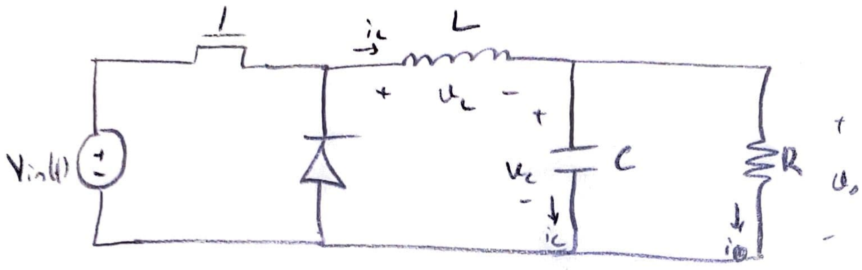
$$\langle i_L \rangle_{T_s} = \frac{1}{T_s} \int_{t}^{t+T_s} i(\tau)\, d\tau$$

↳ moving average
(Low-pass filter)





$$\langle i_L \rangle_{T_s} = I_L + \hat{i}_L$$

$$\langle v_L(t) \rangle_{T_s} = L \frac{\partial \langle I_L(t) \rangle_{T_s}}{\partial t} = L \frac{\partial (I_L + \hat{i}_L)}{\partial t}$$

D: duty cycle

$$\langle v_L(t) \rangle_{T_s} = (D + \hat{d})(\langle v_{in}(t) \rangle_{T_s} - \langle v_o(t) \rangle_{T_s}) + (1 - D - \hat{d}) \langle -v_o(t) \rangle_{T_s}$$

$\langle v_{IN} + \hat{v}_{in} \rangle$

$-(V_o + \hat{v}_o)$

$$L \frac{(\partial I_L)}{\partial t} + L \frac{\partial \hat{i}_L}{\partial t} = D V_{IN} + \hat{d} V_{IN} + D \hat{v}_{in} + \hat{d} \hat{v}_{in}$$

→ ignore this term since AC signals are very small compared to DC part.

$$\therefore \quad L \frac{\partial \hat{i}_L}{\partial t} = \hat{d} V_{in} + D \hat{v}_{in} - \hat{v}_o$$

(AC equation)

$$L \frac{\partial I_L}{\partial t} = D V_{IN} - V_o$$

(DC equation)