# Average Representation of a Switching Power-Pole

Switching information is removed:

- Design the feedback controller
- Studying the dynamic behavior
  - Much faster simulation

Average Representation of PWM Block:

(a)

(b)

$$v_c(t) \longrightarrow \boxed{\frac{1}{\hat{V}_r}} \longrightarrow d(t) = \frac{v_c(t)}{\hat{V}_r}$$

2
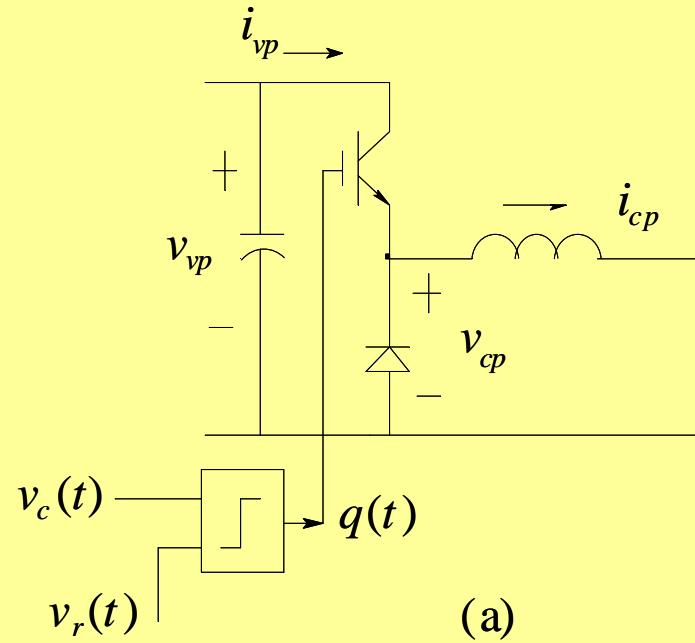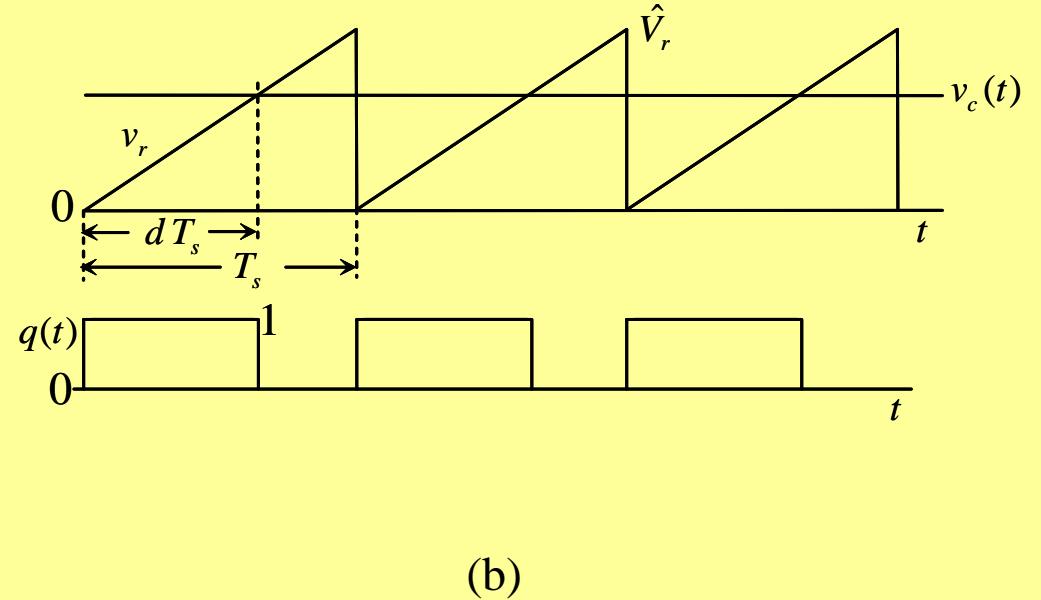
Average Representation of Switching Power-Pole in CCM:

$i_{vp} \longrightarrow$

$+$

v_{vp}

$-$

$+$

v_{cp}

$-$

$\longrightarrow i_{cp}$

$v_c(t)$ ———

$v_r(t)$

$\longrightarrow q(t)$

(a)

$I_{vp} \longrightarrow$

$+$

V_{vp}

$I_{cp} \longrightarrow$

$+$

V_{cp}

$-$ $-$

$1:D$

(b)

$V_{cp} = D V_{vp}$

$I_{vp} = D I_o$

$\overline{i}_{vp} \longrightarrow$

$+$

$\overline{v}_{vp}$

$-$

$\longrightarrow \overline{i}_{cp}$

$+$

$\overline{v}_{cp}$

$-$

$1:d(t)$

$v_c(t)$ ——— $\frac{1}{\hat{v}_r}$

(c)
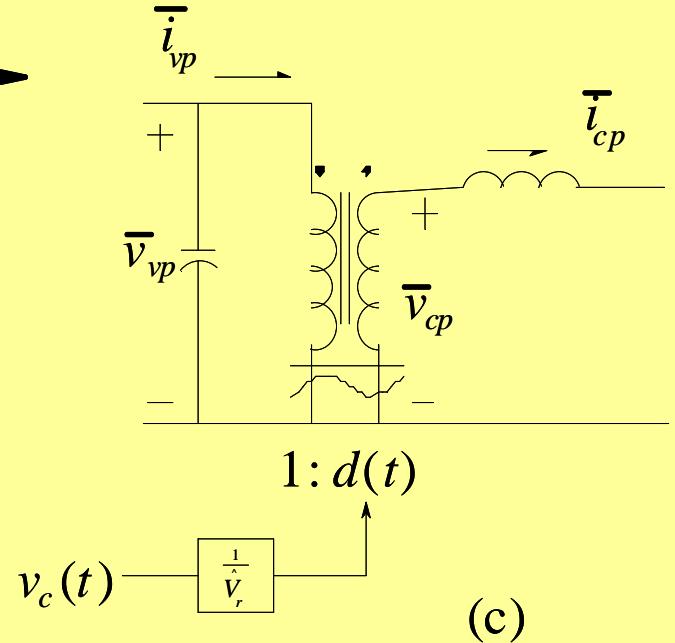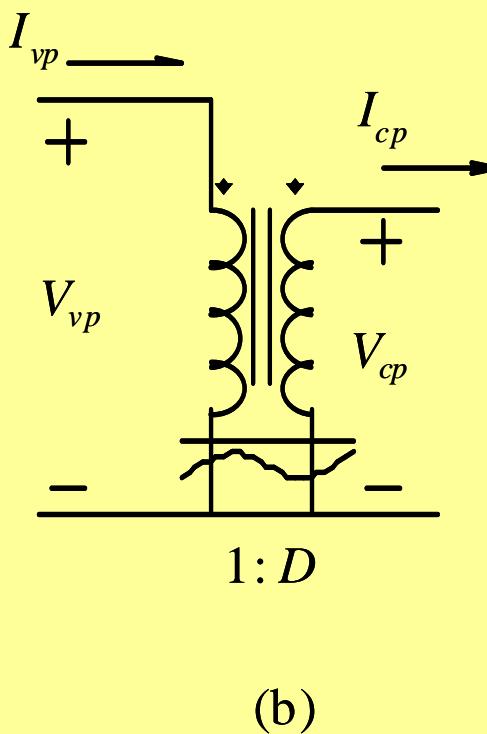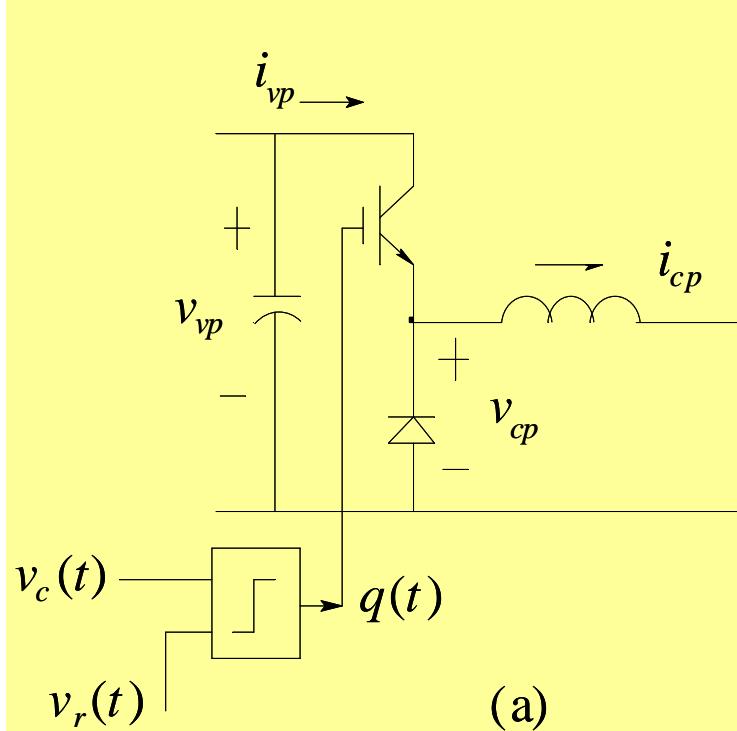
$\overline{v}_{cp}(t) = d(t)\overline{v}_{vp}(t)$

$\overline{i}_{vp}(t) = d(t)\overline{i}_{cp}(t)$

Average dynamic representations of three dc-dc converters in CCM:
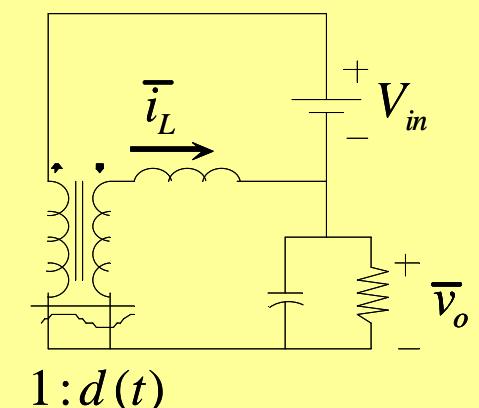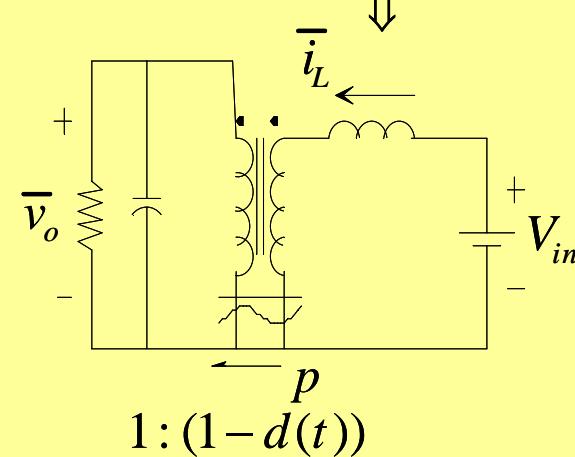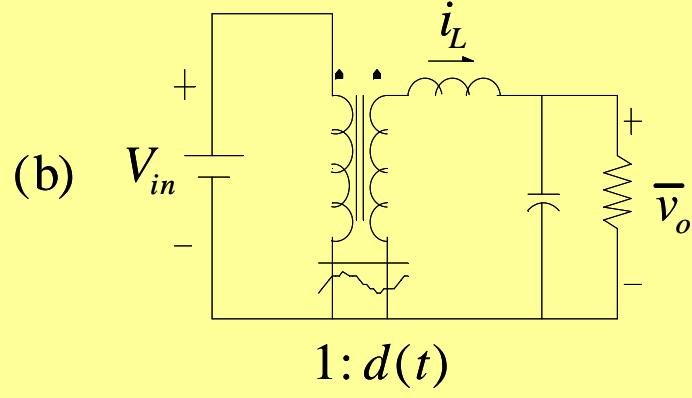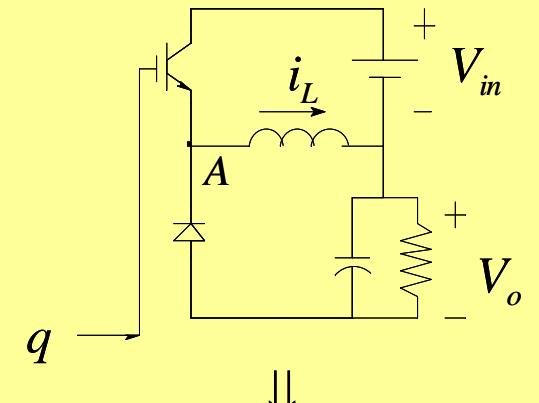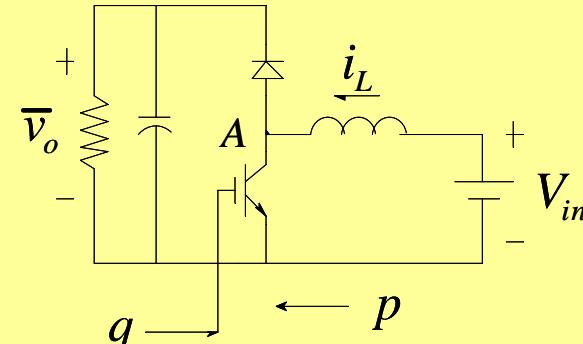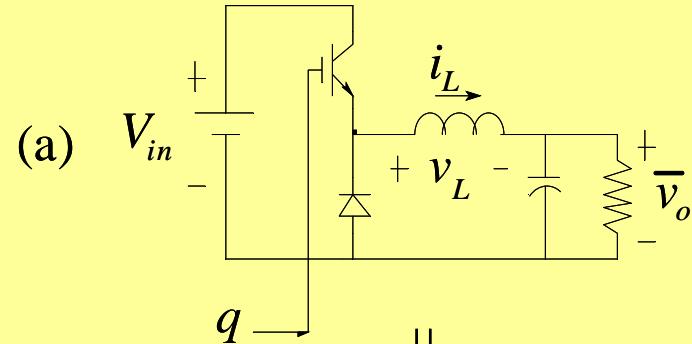
PSpice Modeling (Switching Representation):
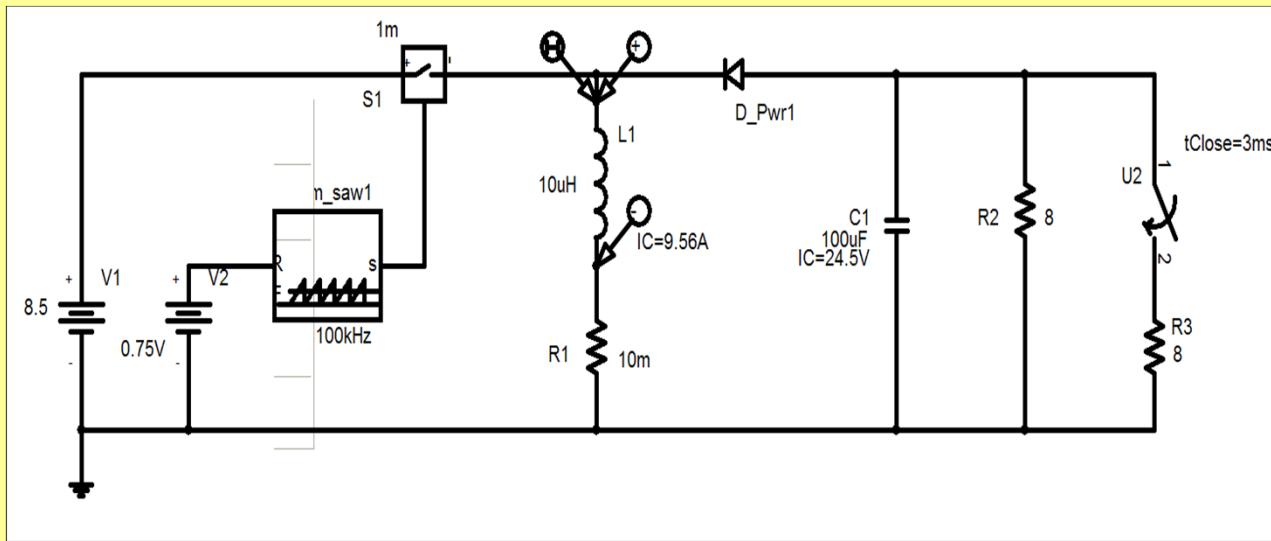
# PSpice Modeling (Average Representation):
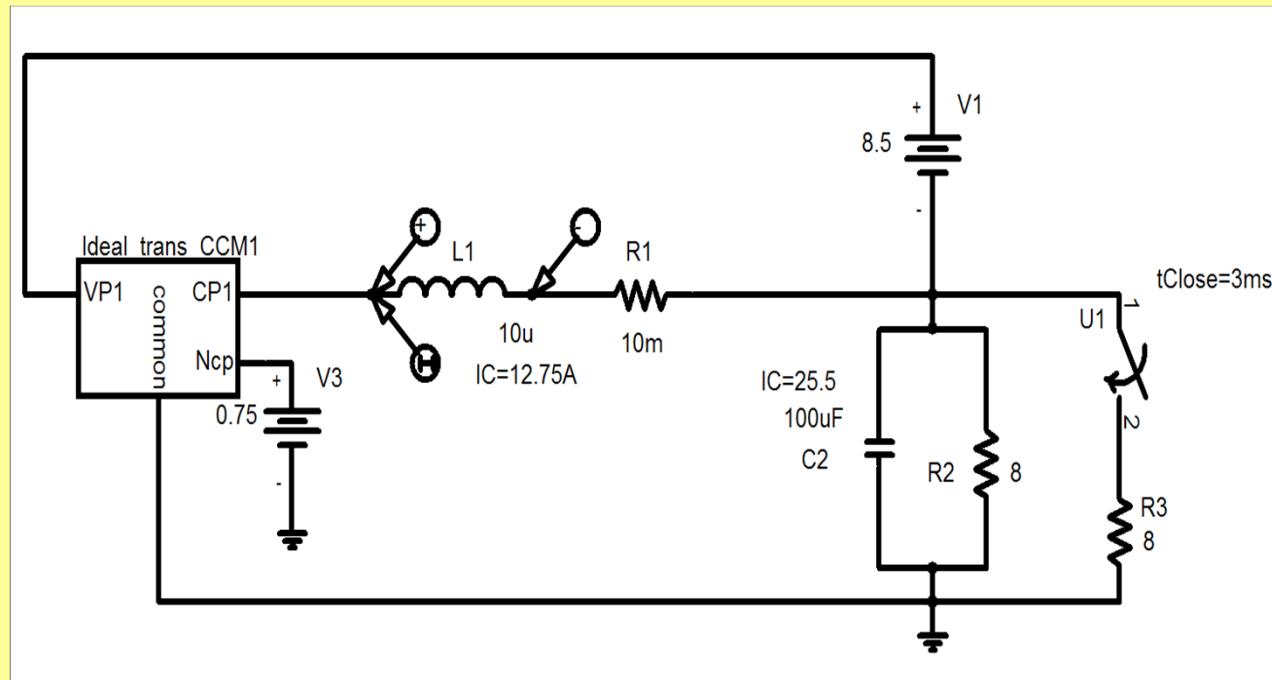
Simulation Results
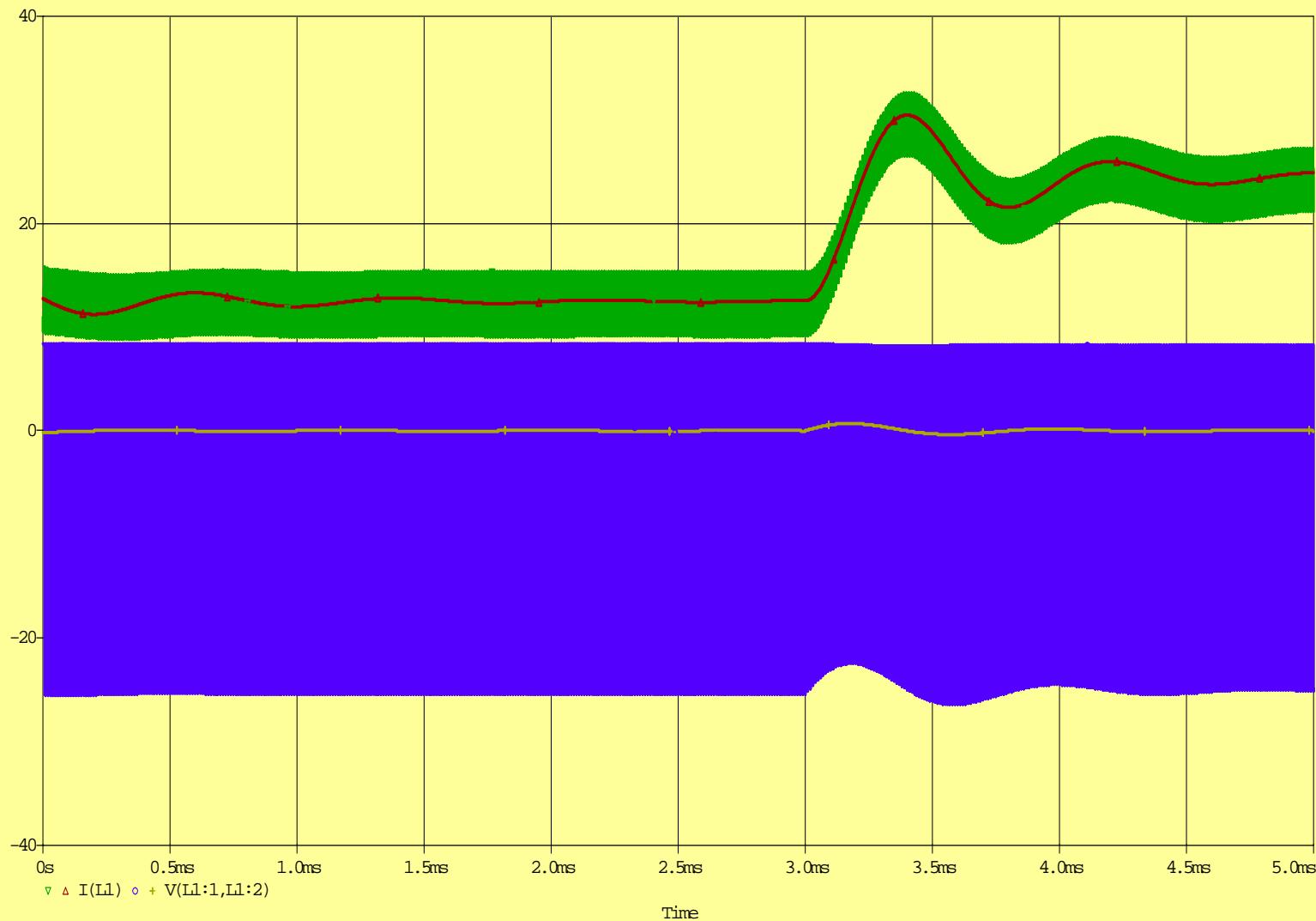
Average representation of a bi-directional switching power-pole:

Buck *Boost*

V_{in} i_L q $q^- = (1-q)$

(a)

Buck

V_{in} $q = 1$ $q = 0$ q q^-

(b) i_L = positive

Boost

V_{in} $q^- = 0(q = 1)$ $q^- = 1(q = 0)$ q q^-

(c) i_L = negative

Buck *Boost*

V_{in} i_L q $q^- = (1-q)$

(a)

$q = 1$ i_L q

(b)

V_{in} $\overline{i_L}$ $1:d$
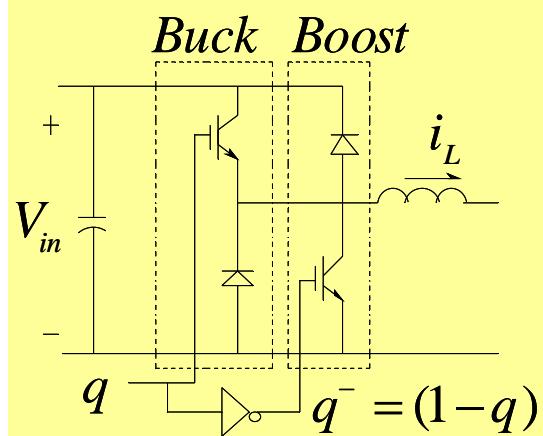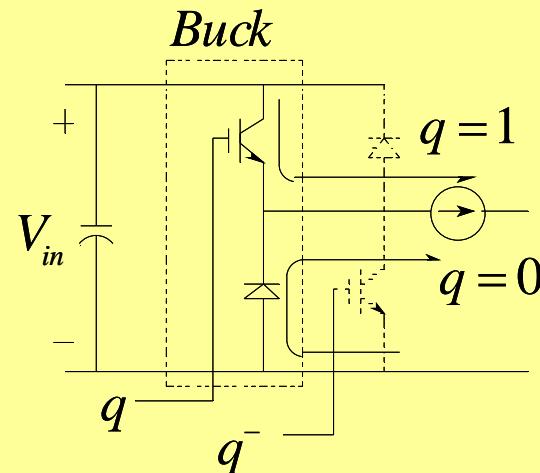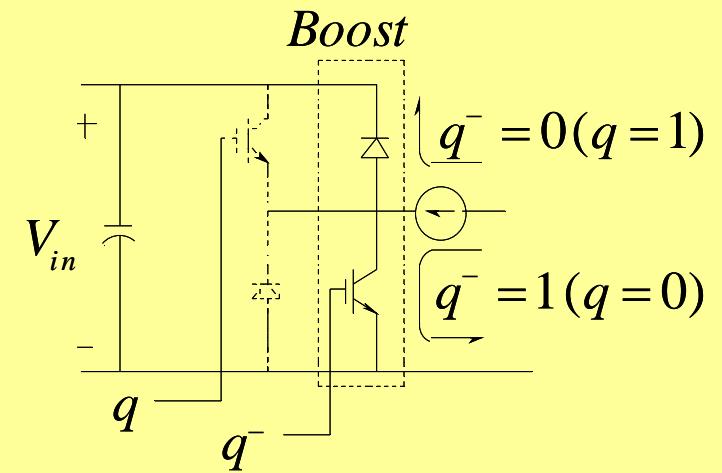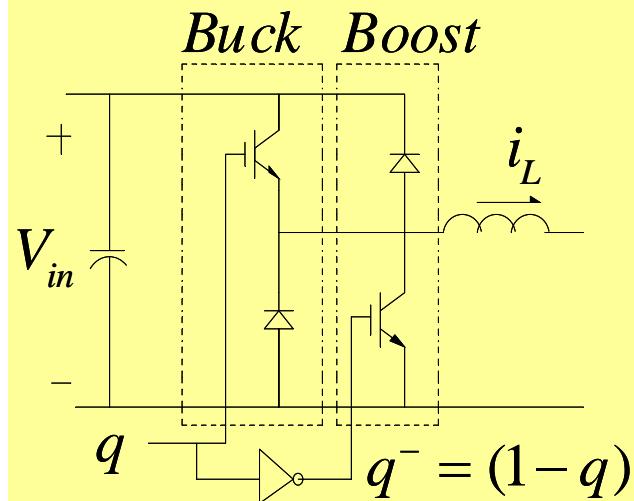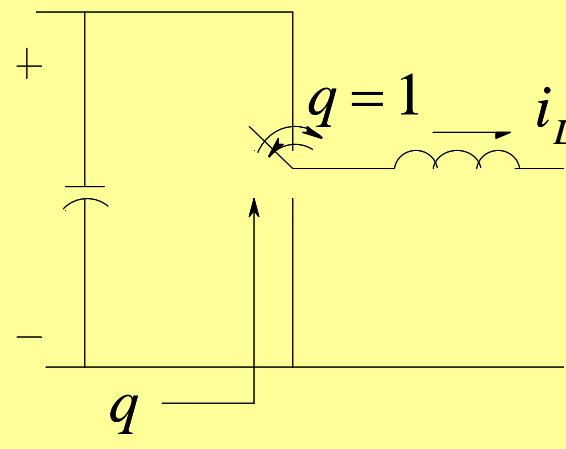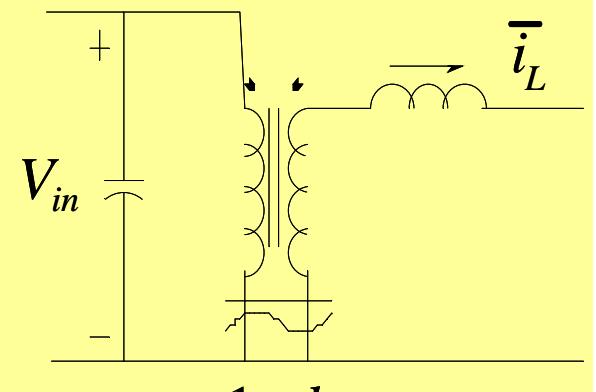
(c)

Summary

- Average representation of a switching power-pole
  - Developing the feedback controller
  - Studying the dynamic behavior
    - Much faster simulation