



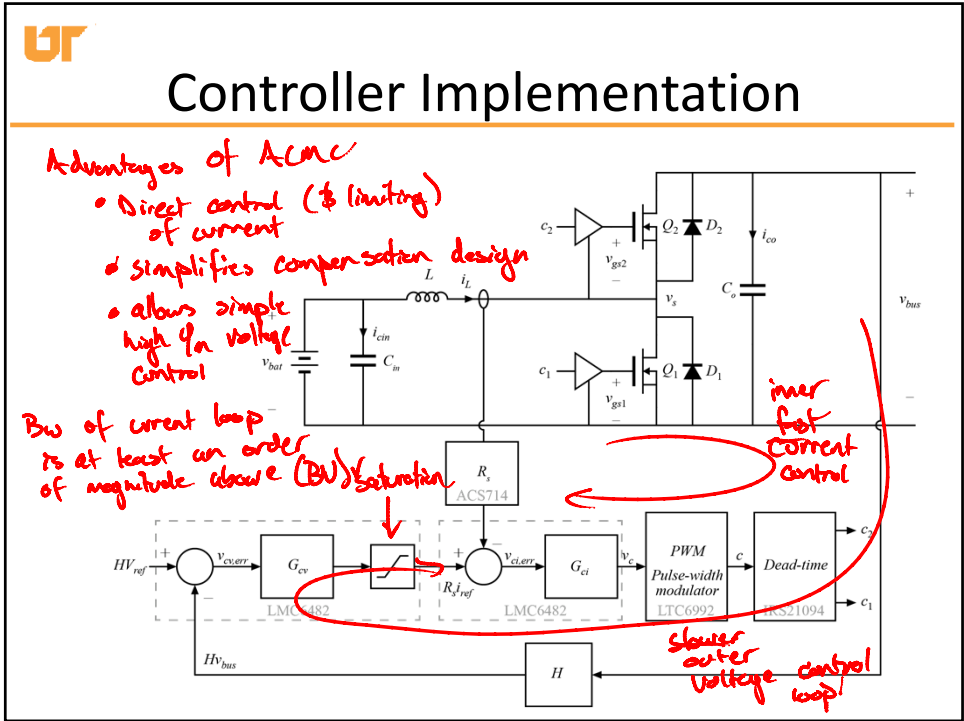
Boost Controller Design (cont.)

ECE 482 Lecture 8
February 7, 2014



Announcements

- Experiment #2 report moved to Friday 2/14
- Reverse power flow tests removed from procedure; EC if completed



Open-Loop Control-to-Current TF

$$G_{id}(s) = \frac{\hat{i}_L}{\hat{d}} \Big|_{\hat{v}_{bat}=0, \hat{i}_{bus}=0} = G_{ido} \frac{1 + \frac{s}{\omega_{zi}}}{1 + \frac{s^2}{\omega_o^2}}$$

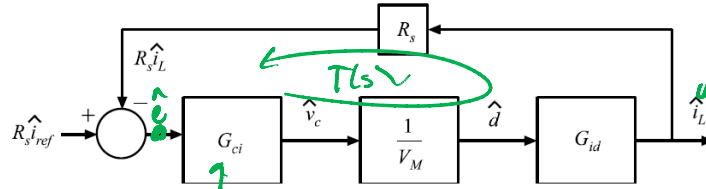
$$G_{ido} = \frac{I_L}{D'} = \frac{I_{bus}}{(D')^2}$$

$$f_{zi} = \frac{1}{2\pi} \frac{1}{C} \frac{I_{bus}}{V_{bus}}$$

$$f_o = \frac{1}{2\pi} \frac{D'}{\sqrt{LC}}$$



Current Loop Gain



$$T(s) = G_{ci} \frac{1}{V_M} G_{id} R_s$$

$$\hat{e} = R_s \hat{i}_{ref} - R_s \hat{i}_L = R_s \hat{i}_{ref} - R_s G_{id} \frac{1}{V_M} G_{ci} \hat{e}$$

$$\hat{e} = R_s \hat{i}_{ref} - T(s) \hat{e}$$

$$\hat{e} = \frac{R_s \hat{i}_{ref}}{1 + T(s)}$$

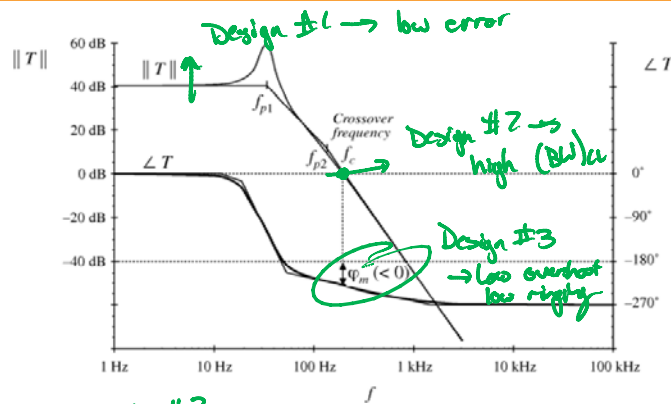
$$\hat{i}_L = \hat{e} G_{ci} \frac{1}{V_M} G_{id}$$

$$\hat{i}_L = \hat{i}_{ref} \frac{I}{1+T}$$

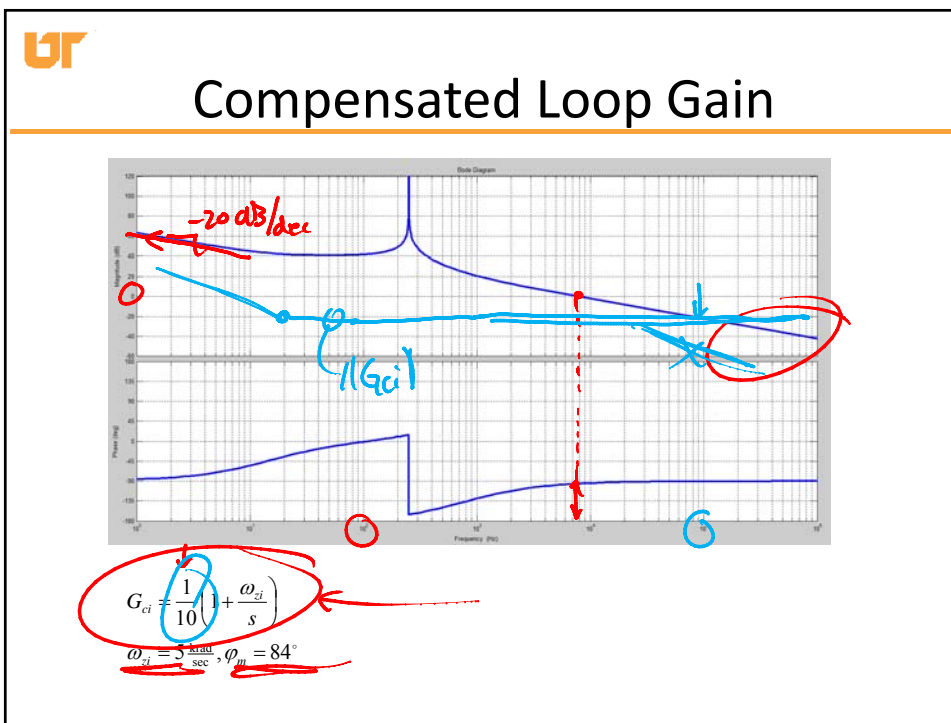
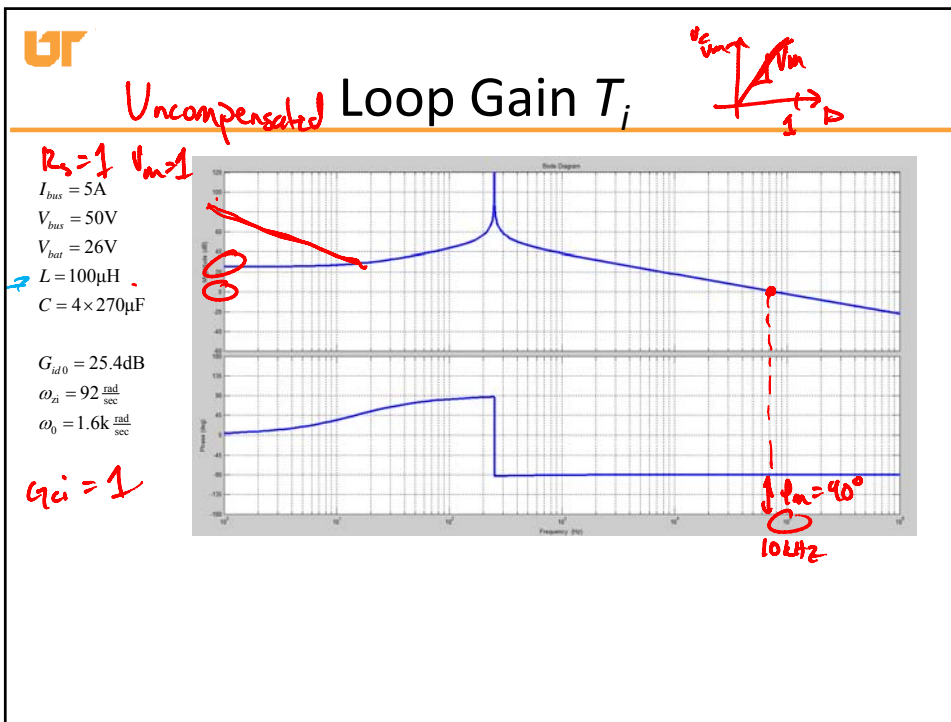
Design goal #1: Large $T(s)$ over wide range of freqs. $T(s \rightarrow \infty) \rightarrow \infty$
 Design goal #2: Extend range of freq w/ $|T(s)| > 1$



Loop Gain & Stability

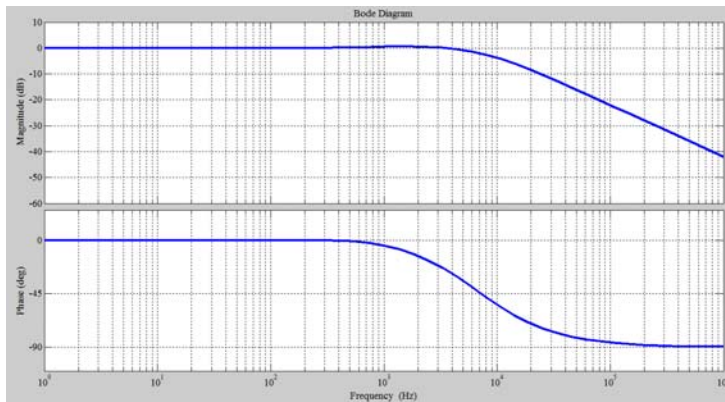


Design Goal #3
 System well stabilized
 → large PM





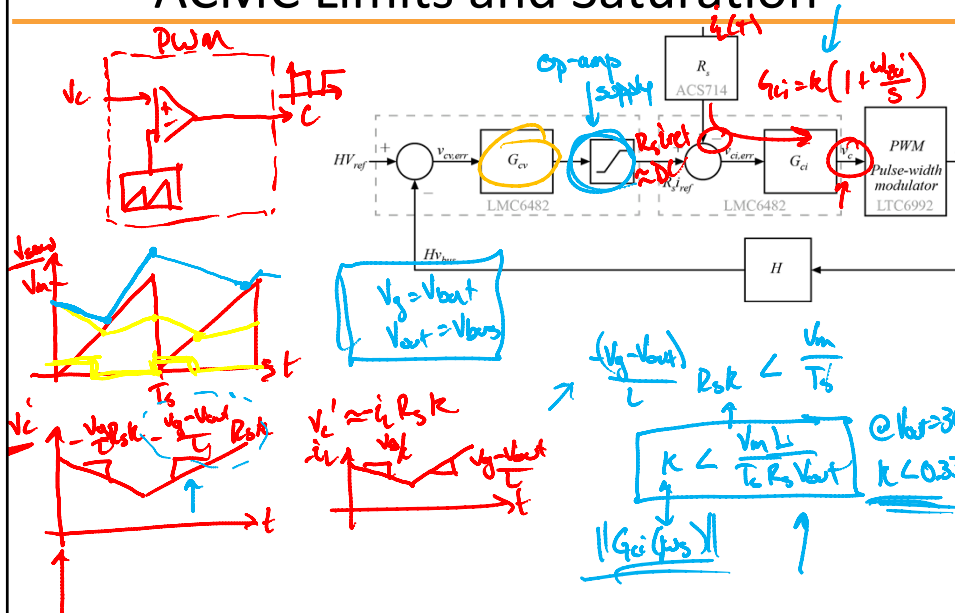
Closed Loop G_i

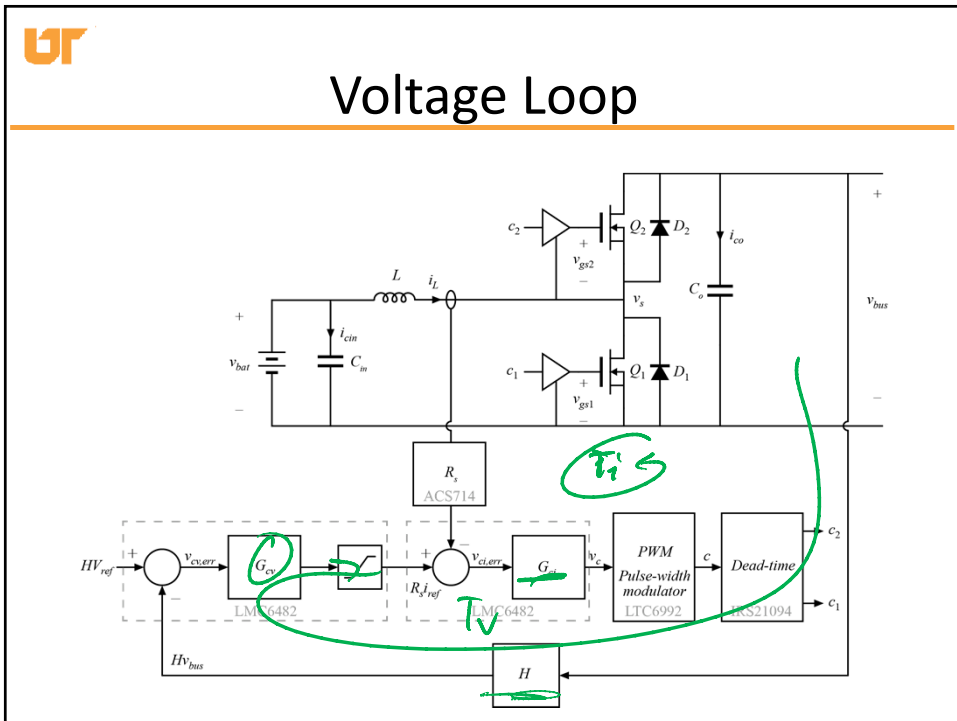
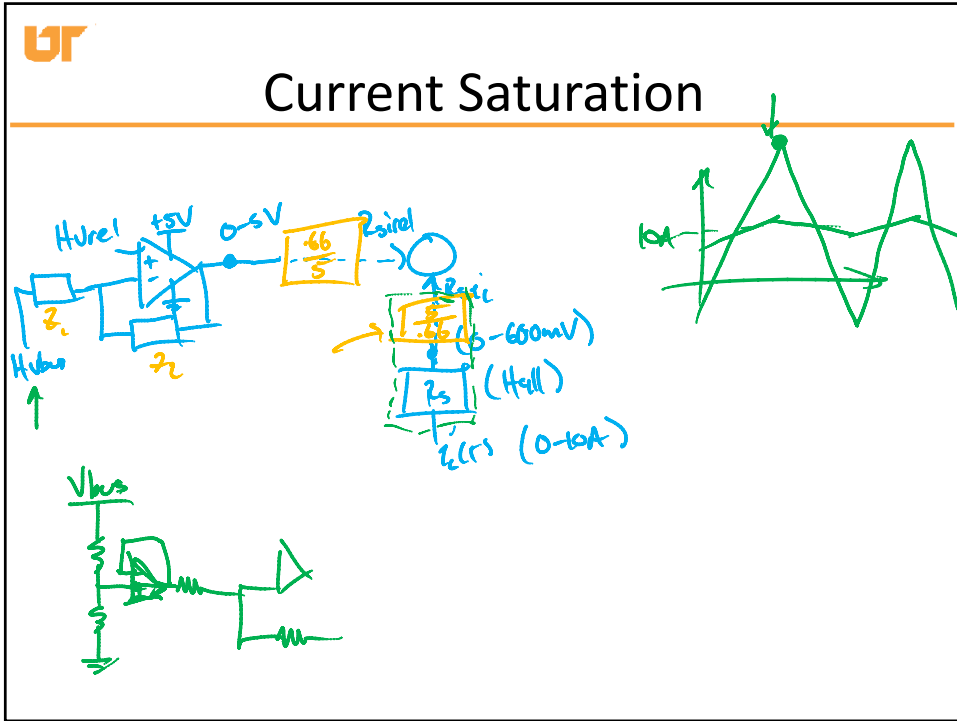


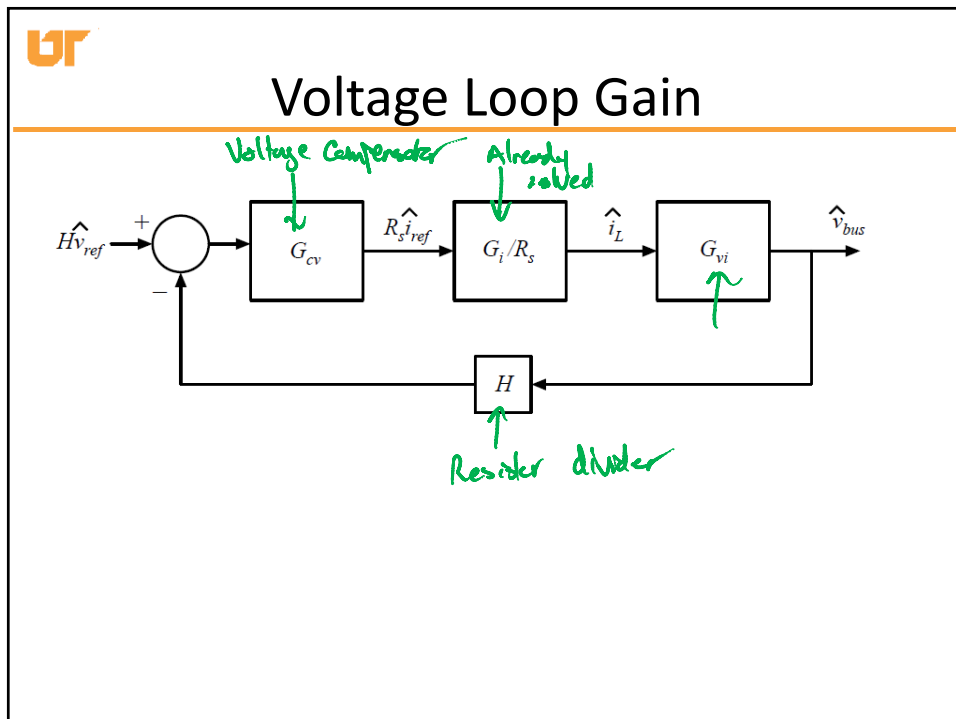
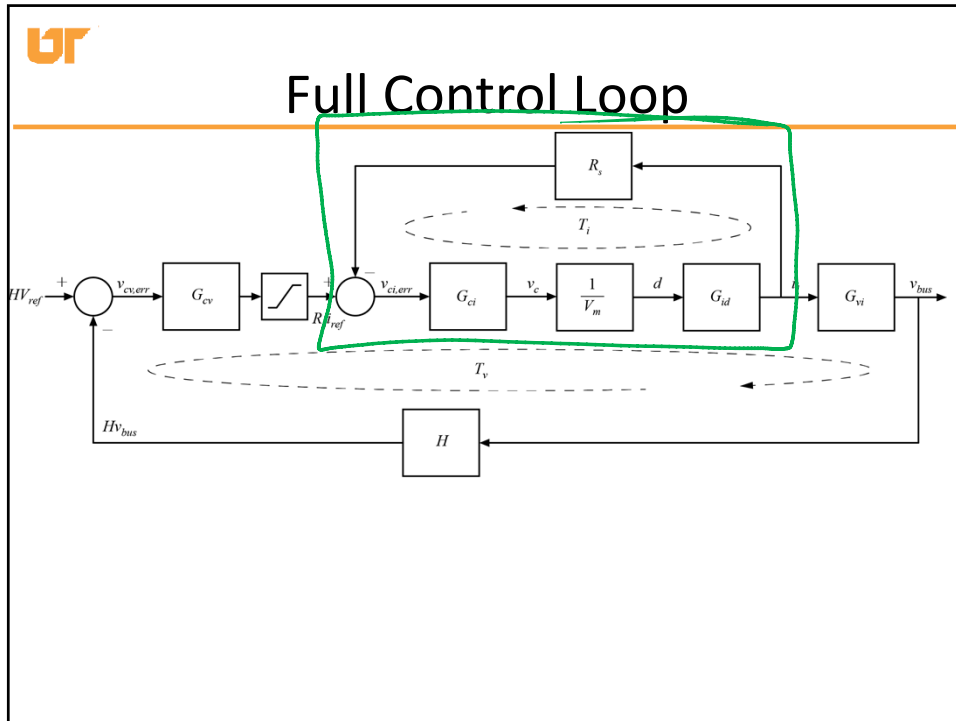
$$G_i = \frac{T_i}{1 + T_i}$$



ACMC Limits and Saturation

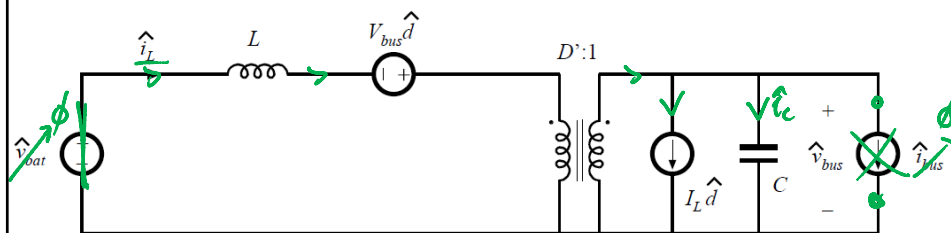








Solving G_{vi}



$$G_{vi} = \frac{\hat{v}_{bus}}{\hat{i}_L} \Big|_{\hat{v}_{bar}=0, \hat{i}_{bus}=0}$$

$$\hat{v}_{bus} = \frac{1}{sC} \hat{i}_c = \frac{1}{sC} (\hat{i}_c D' - I_L \hat{d})$$

$$G_{id} = \frac{\hat{i}_c}{\hat{d}} \rightarrow \hat{d} = \frac{\hat{i}_c}{G_{id}}$$

$$\hat{v}_{bus} = \frac{1}{sC} (\hat{i}_c D' - \frac{I_L}{G_{id}} \hat{i}_c)$$

$$G_{vi} = \frac{\hat{v}_{bus}}{\hat{i}_c} = \frac{1}{sC} \left(D' - \frac{I_L}{G_{id}} \right)$$