**Closed-Loop Bridge Converter Plus Averaged Model**

**DC-DC Converter Example**

- The $k_i$ and $k_p$ should be tuned for the $R_s$ and $L_s$ values of this system

As per page 51 in the text book by Yazdani and Iravani:

- Desired time constant: $\tau_i := 0.005$

  $R_S := 0.00588$ $L_S := 0.69 \times 10^{-3}$

We know that: $\frac{k_i}{k_p} = \frac{R_S}{L_S}$ and $\frac{k_p}{L_S} = \frac{1}{\tau_i}$

So: $k_p := \frac{L_S}{\tau_i}$ $k_p = 0.138$ $k_i := \frac{R_S}{L_S}$ $k_i = 1.176$

- Switching and averaged models match, but
- Poor current tracking at startup and for changes
- And for changing conditions
Here are the current reference and current from the averaged model.

Add feedforward term, VS2

Now much better tracking at startup
Can see the effect of time constant in the transition between setpoints
- modulation function

- output of PI (red)
- output of PI + voltage
- feedforward input (green)
**DC-AC Application**

Create sinusoidal \( i_{\text{ref}}(t) \) function

- Significant tracking problem
- Trying to track an time varying reference
- Try lowering the time constant of the PI loop:
  - New desired time constant: \( \tau_i := 0.0005 \)

So:

\[
\begin{align*}
  k_p &:= \frac{L_S}{\tau_i} \quad \text{So: } k_p = 1.38 \\
  k_i &:= k_p \cdot \frac{R_S}{L_S} \quad \text{So: } k_i = 11.76
\end{align*}
\]

- Now tracks magnitude
- Still have a phase error that would require additional compensation
- There are other PWM schemes we could use as well
• Note that modulating function hints limits during the higher current output state

• Due to the high current reference

• Converter terminal voltage from switched and averaged models