ECE 404-TD / 504-TD

ST: T&D APPLICATIONS OF VOLTAGE SOURCE CONVERTERS

SESSION no. 32
I. Averaged Converter model in PSCAD/EMTDC

- Switching Power circuit

ECE 404/504
T&D Applications of Voltage Sourced Converters

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Spring 2013
- Gate Control and Modulation

![Diagram of gate control and modulation system]
• Averaged Model: Power Circuit

\[ R_0 \]
\[ V_{pos_{av}} \]
\[ V_{neg_{av}} \]

\[ IP \]
\[ V_{at} \]
\[ I_{L_{av}} \]

\[ 0.00069 \text{ [H]} \]
\[ 0.00588 \text{ [ohm]} \]

\[ V_{at} \]

\[ DC \text{ source} \]
\[ \text{external input} \]
- Averaged Model: Control Equations

\[ v_t = m \frac{v_{dc}}{2} \]

\[ i_p = \frac{(1 + m)}{2} i_{out} \]

\[ i'_n = \frac{(1 - m)}{2} i_{out} \]

- Inverter Case: Change sources and modulation function
- Closed loop control (DC-DC first)
  \(\rightarrow\) Add control measurements

\[\text{Averaged Model}\]

\(\text{Control circuit}\)

\[\text{PI}\]

\[K_i = 1.176, \quad K_p = 0.138\]
Input Filtering and Phase Correction

Synchronization

- Detect zero crossing of input fundamental frequency waveform
  - Possibly delay by 90 degree to get peak
  - Proper delay requires knowledge of actual system frequency (not the ideal value)
  - Inputs include phase error (from measuring circuit and system drift), and base frequency
- Note use of “analog” signals, could do this digitally as well