Impact of Fundament Rules of Power Electronics on Converter Topologies

- Design such that switch actions connect a voltage source (C) to a current source (L)
  » Sometime rotating machines substitute either
- Circuit design and control design to protect switches from overcurrent

Topologies

- Diode rectifiers
- Thyristor controlled rectifiers/inverters
  » Current source converters
- DC/DC converters
- Switched mode power supplies
- Voltage sourced converters
- Transformer coupled converters
- Thyristor controlled reactor or capacitor
Single Switch DC/DC Converters: Buck Converter (step down)

- One controlled switch

\[ V_o = D \cdot V_d \]

Using average values

Inductor current

\[ I_d = D \cdot I_o \]

Using average values

Switch and diode currents

\[ I_d = D \cdot I_o \]

Using average values
**Single Switch DC/DC Converters:**

**Boost Converter**

- One controlled switch

\[ V_o = \frac{V_d}{1-D} \]

Using average values

- Input current can be continuous
- Can combine with rectifier

**Buck/Boost Converter**

- One controlled switch

\[ V_o = D \cdot \frac{V_d}{1-D} \]

Using average values
Half Bridge Converter

- Start from buck converter
- If split the left side with two capacitors can produce positive or negative output voltage
- Can use for DC-AC conversion

Basic Idea Behind VSC

- Goal is to synthesize ac voltage waveform from dc voltage source
- Current follows from voltage different across ac side R-L circuit
- Different avenues to improve quality of the voltage and current waveform
- Scaling to high power applications
- Different topologies as a result
**Simple dc/dc Example**

**Simple dc/ac Example**

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Voltage Sourced Converters  
Lecture 7  
Spring 2023  

- Carrier and voltage reference
- Switch and inductor currents
Simple dc/ac Example

AC voltage: converter terminal and external source voltages

Inductor current