Power Converter Systems

Graduate Course EE8407

Bin Wu PhD, PEng

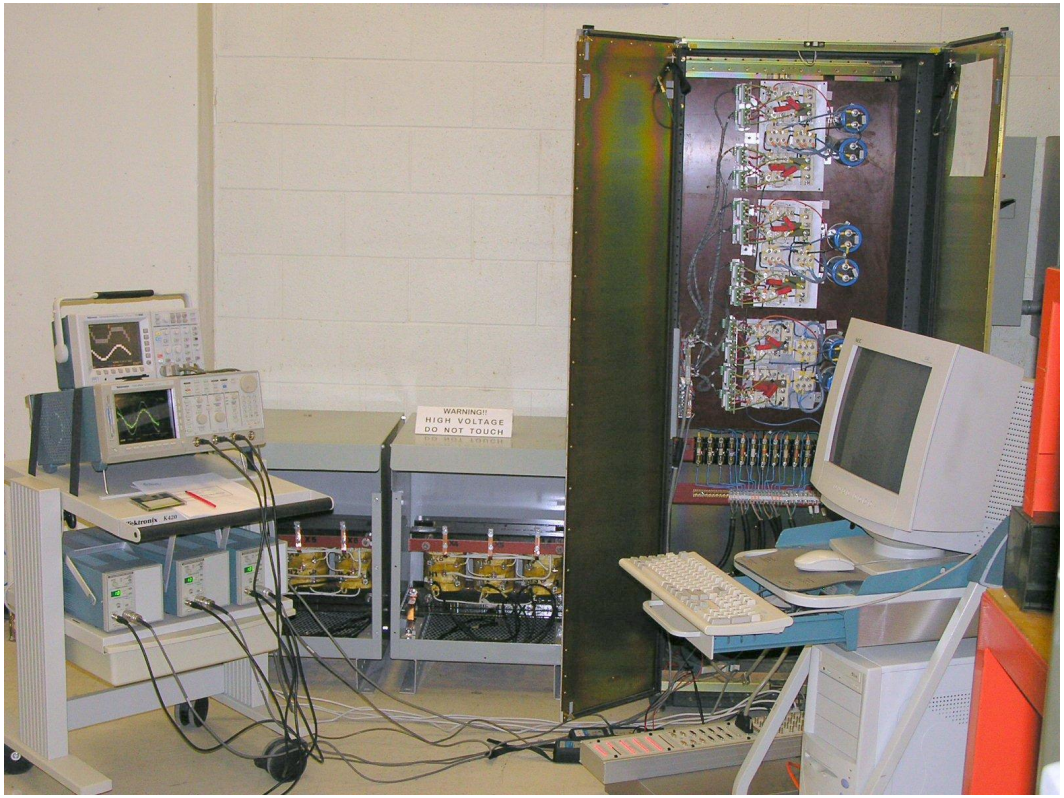
Professor
ELCE Department
Ryerson University

Contact Info
Office: ENG328
Tel: (416) 979-5000 ext: 6484
Email: bwu@ee.ryerson.ca
http://www.ee.ryerson.ca/~bwu/

Ryerson Campus

Topic 8

Other Multilevel Voltage Source Converters



Five-Level NPC/H-Bridge Inverter System with dual 18-pulse rectifier

LEDAR, Ryerson University

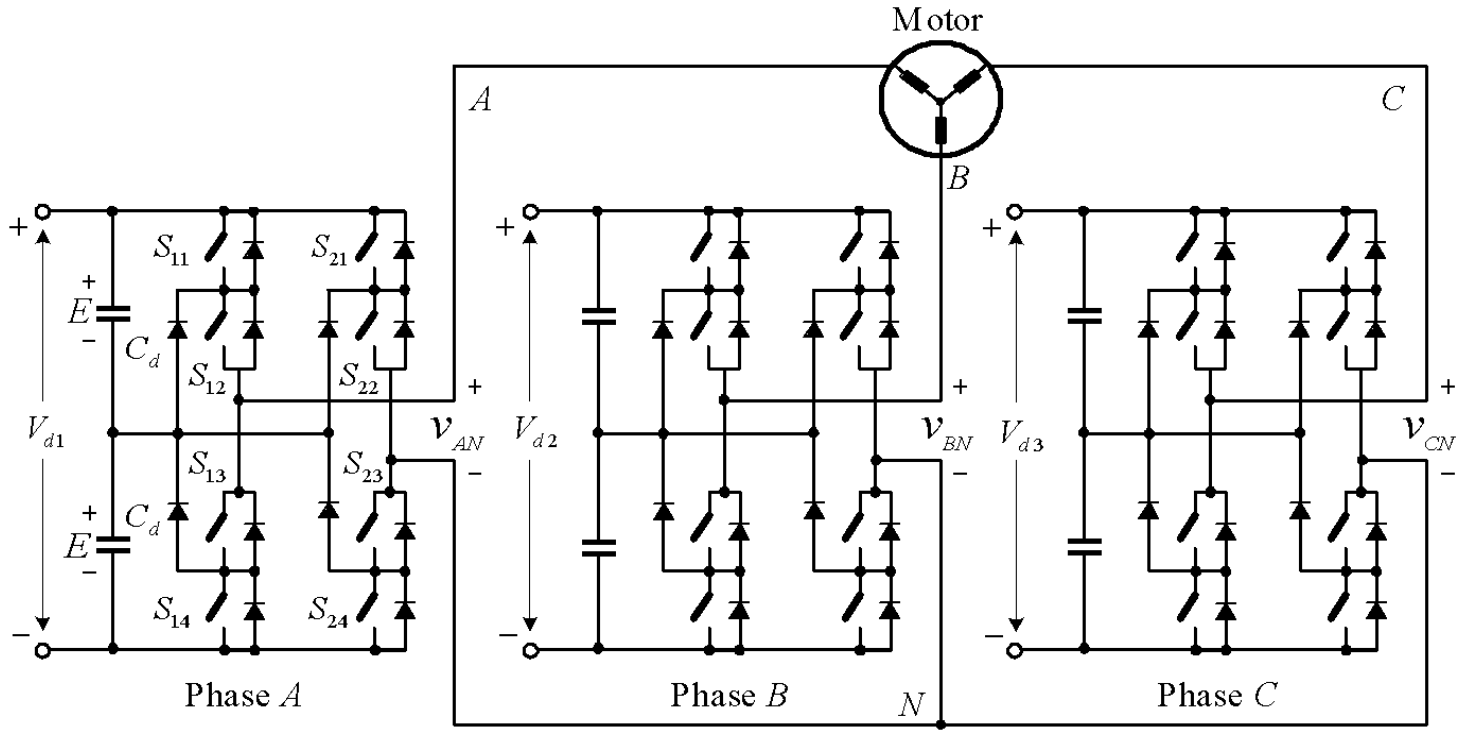
Other Multilevel Voltage Source Converters

Lecture Topics

- NPC/H-Bridge Inverters
- Flying-Capacitor Inverters

NPC/H-Bridge Inverters

- **Five-Level Topology**



Compared with three-level NPC Topology:

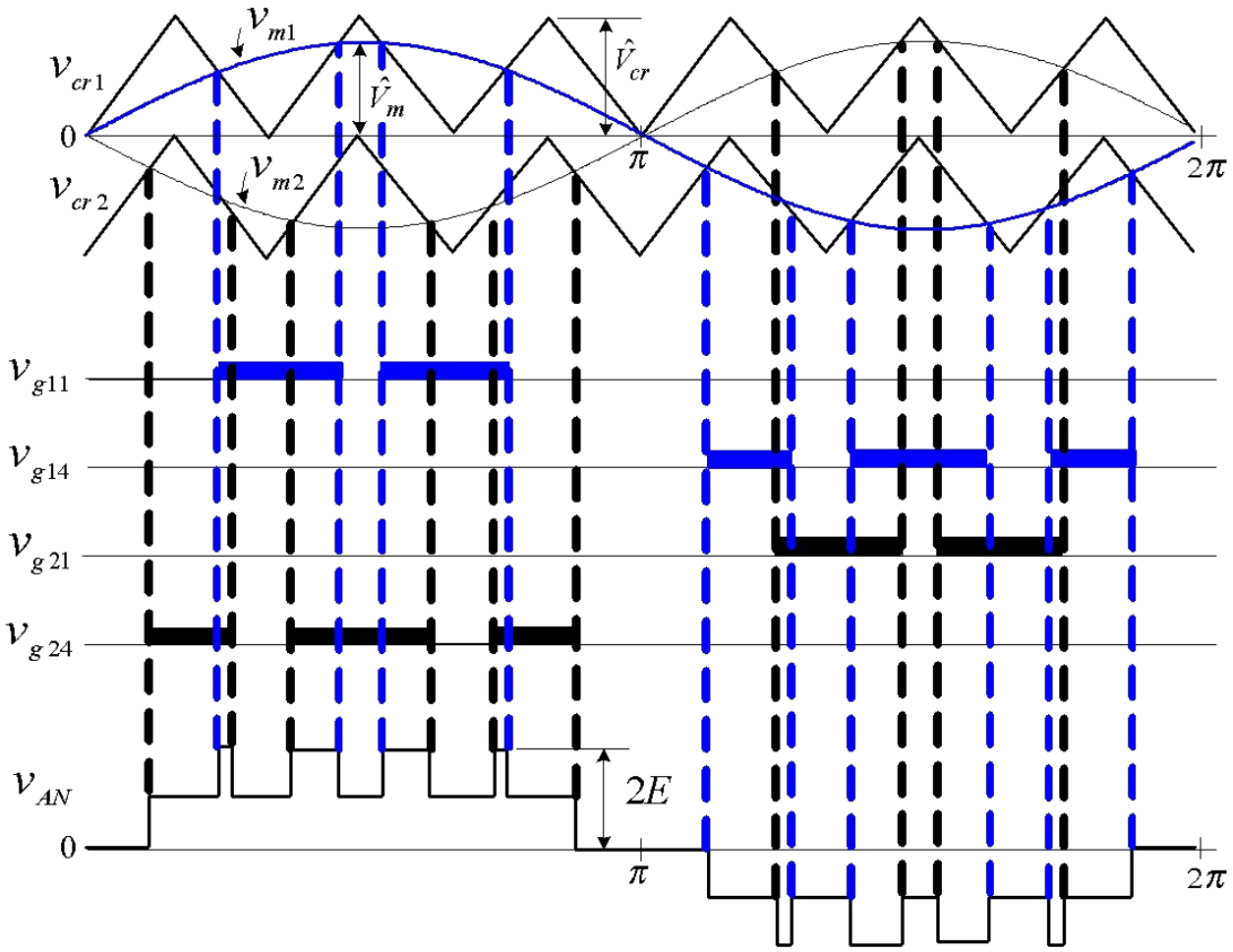
- Voltage levels increases from three to five

- Inverter output voltage and power are doubled

- Device count is doubled

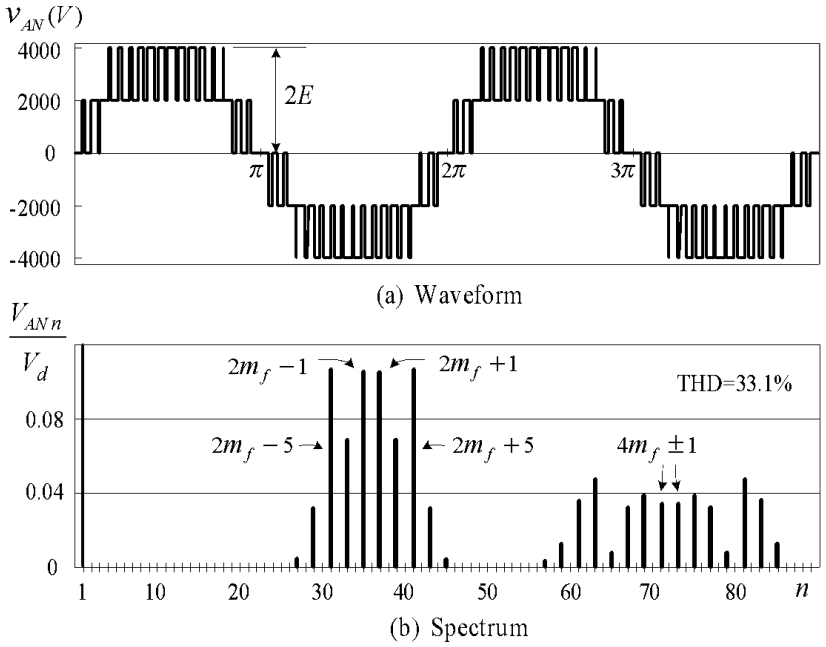
NPC/H-Bridge Inverters

- **IPD Modulation**

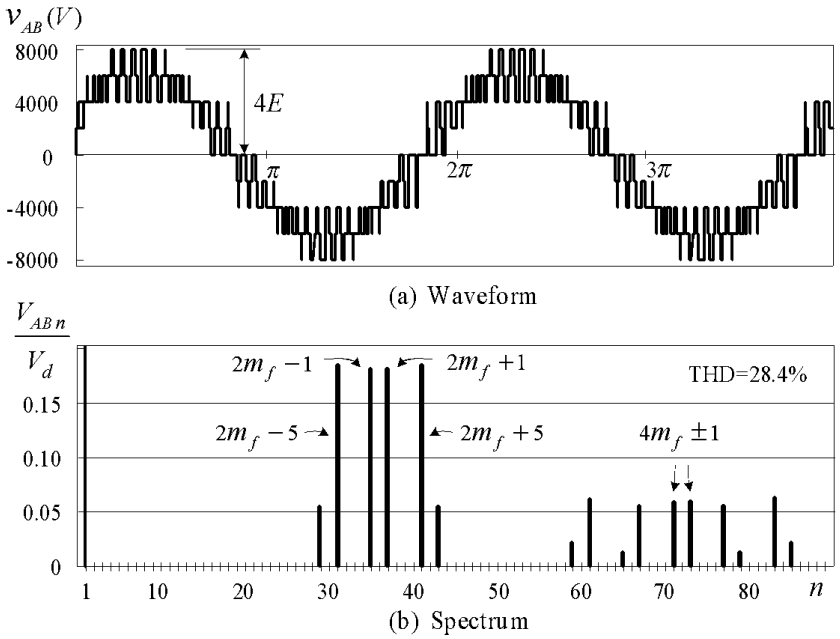


NPC/H-Bridge Inverters

- **Waveforms and FFT (Five Level)**



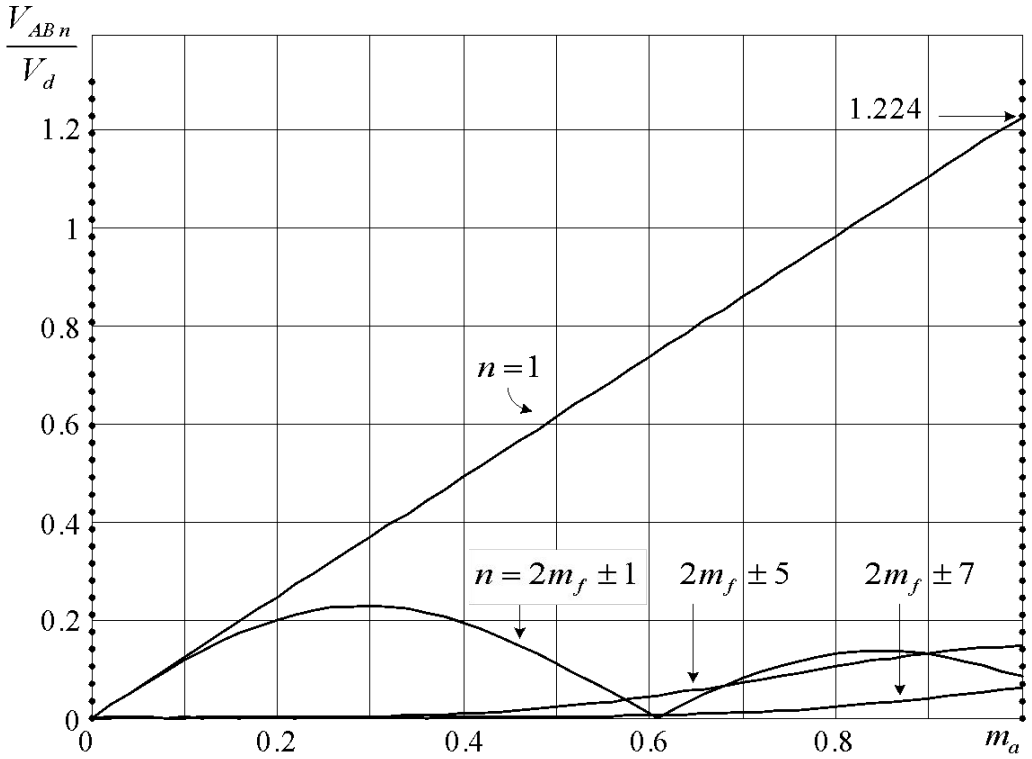
Inverter Phase Voltage



Line-to-line Voltage

NPC/H-Bridge Inverters

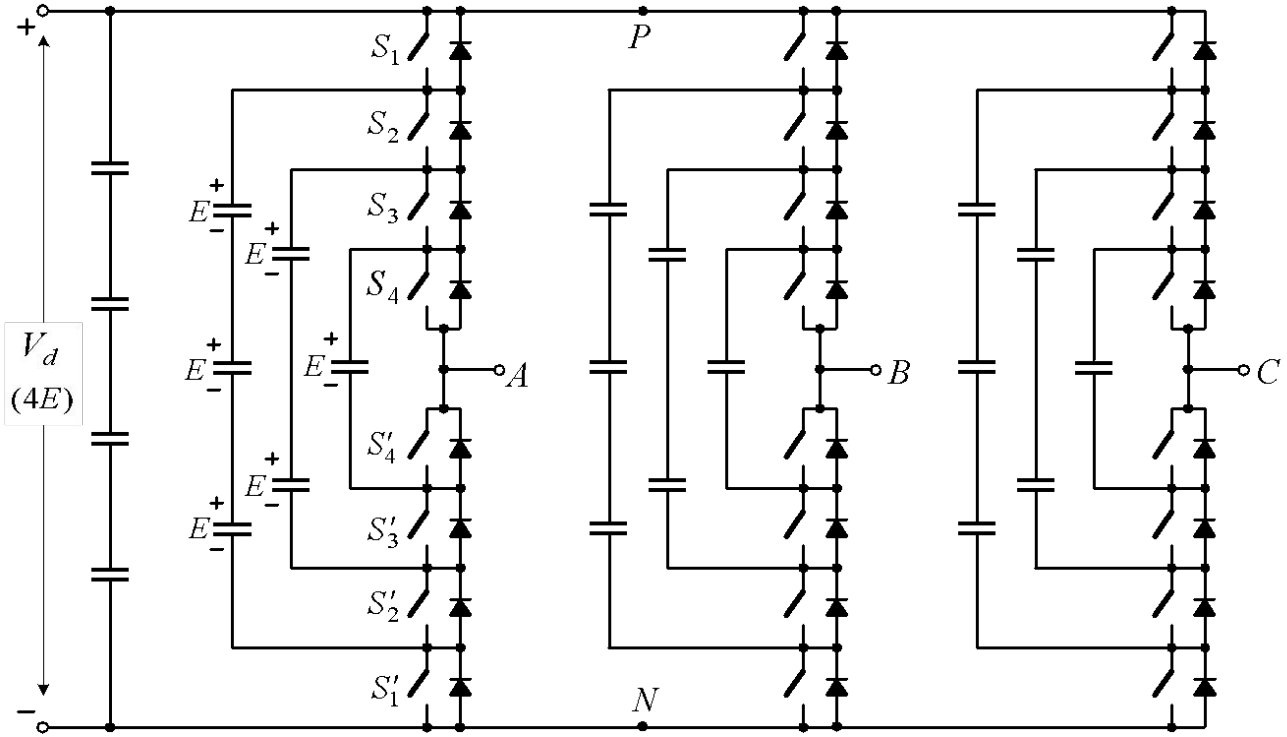
- **Waveforms and FFT (Five Level)**



Frequency modulation index: $m_f = 18$

Multilevel Flying Capacitor Inverters

- Five Level Topology



Complementary Switch pairs:

- S_1 and S'_1;
- S_2 and S'_2;
- S_3 and S'_3;
- S_4 and S'_4;

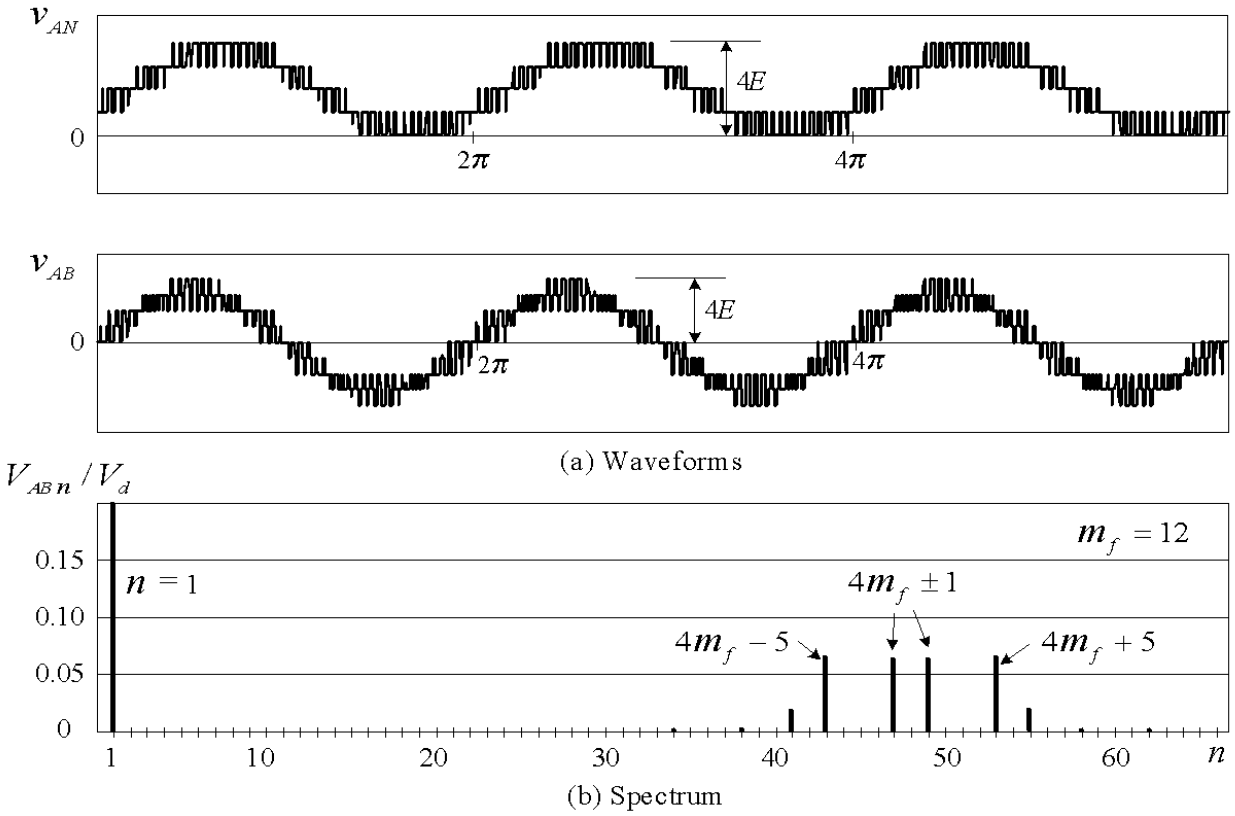
Multilevel Flying Capacitor Inverters

- **Switching State (five-level)**

Output Voltage V_{AN}	Switching State			
	S_1	S_2	S_3	S_4
$4E$	1	1	1	1
$3E$	1	1	1	0
	0	1	1	1
	1	0	1	1
	1	1	0	1
$2E$	1	1	0	0
	0	0	1	1
	1	0	0	1
	0	1	1	0
	1	0	1	0
	0	1	0	1
$1E$	1	0	0	0
	0	1	0	0
	0	0	1	0
	0	0	0	1
0	0	0	0	0

Multilevel Flying Capacitor Inverters

- **Phase-Shifted PWM**



- $f_{sw\ (device)} = 60(m_f) = 720\text{Hz}$
- $f_{sw\ (inverter)} = 60(4m_f) = 2880\text{Hz}$

Multilevel Flying Capacitor Inverters

- Summary

Features

- Low harmonic distortion with low *dv/dt*
- Modular design

Drawbacks

- Large number of dc capacitors
- Complex pre-charging circuits
- Difficulties in dc cap voltage balancing control

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Thanks