

Lab Introduction

Overview

- Power Electronics Engineering Laboratory
- Lab: Bldg. 301, Rm. 513, Seoul National University
- Website: <http://spec.snu.ac.kr>

Research Fields

- Motor Control
- High-Efficiency Power Systems
- Small-Sized Power Systems
- Renewable Energy Conversion systems

Funding



Prof. Jung-Ik Ha



Associate Professor at SNU
Chief Technology Officer (CTO) in LS Mecapion Co.
Senior and Principal Engineer in SAMSUNG Electronics Co.
Researcher in YASKAWA Electric Co.
B.S., M.S., and Ph.D. at SNU

Ph.D. Candidates:



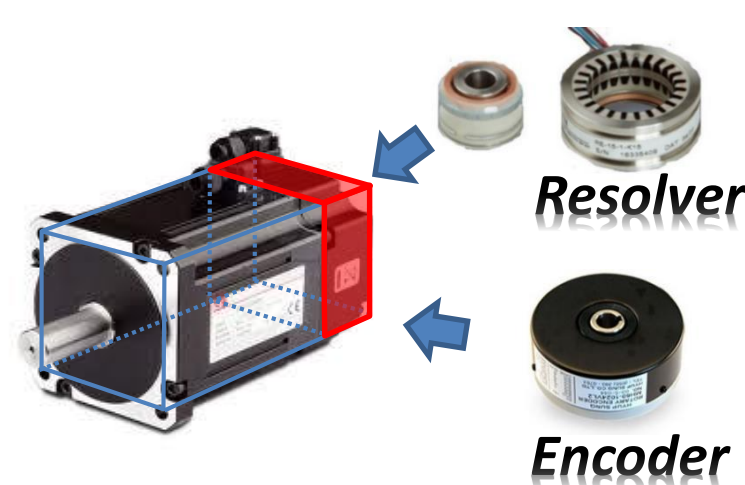
Master Candidates:



Motor Control

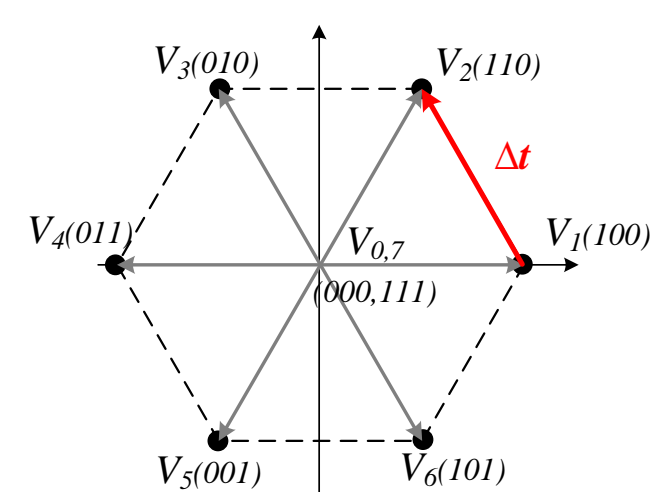
Sensorless Control

- Eliminating position sensor
 - ➔ Cost reduction
 - ➔ Improvement of system reliability
- Back-EMF based method
- Signal injection method



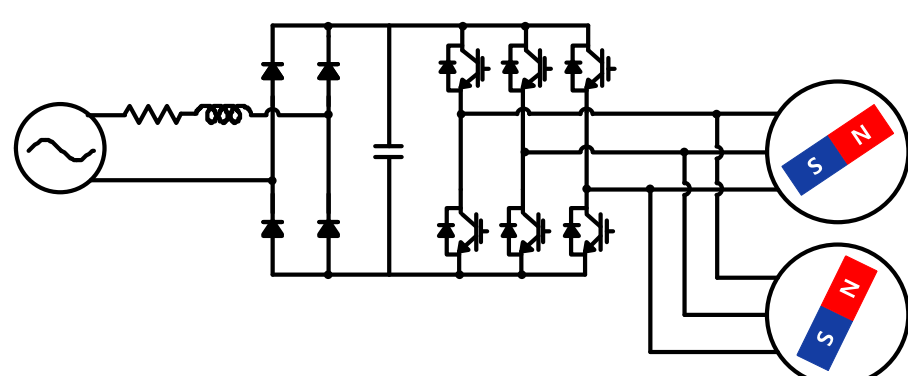
Six-Step Operation

- Inverter output voltage
 - $V_1 \rightarrow V_2 \rightarrow V_3 \rightarrow V_4 \rightarrow V_5 \rightarrow V_6 \rightarrow V_1 \rightarrow \dots$
- Minimum switching loss
- Maximum output torque capability
- Variable time sampling
 - For operating at ultrahigh speed (≥ 50 kr/min)



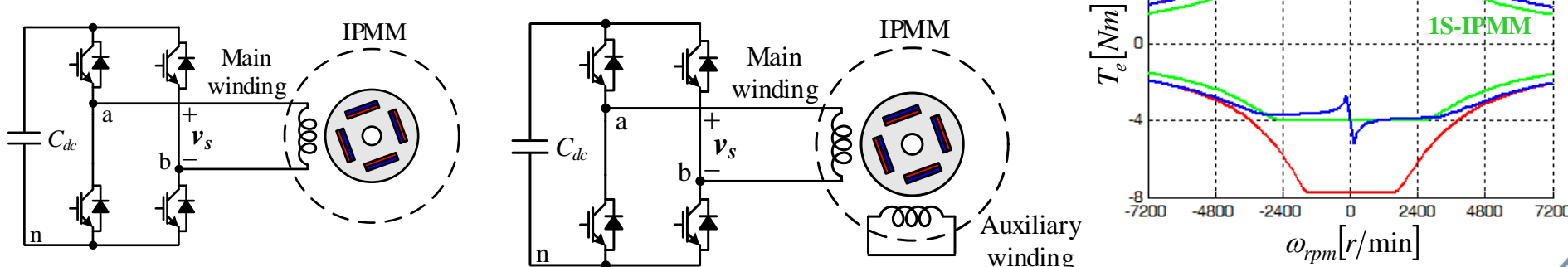
Dual Motor Single Inverter

- Cost reduction
- System simplification
- Application
 - Air conditioner compressor



Single-Phase Stator Control

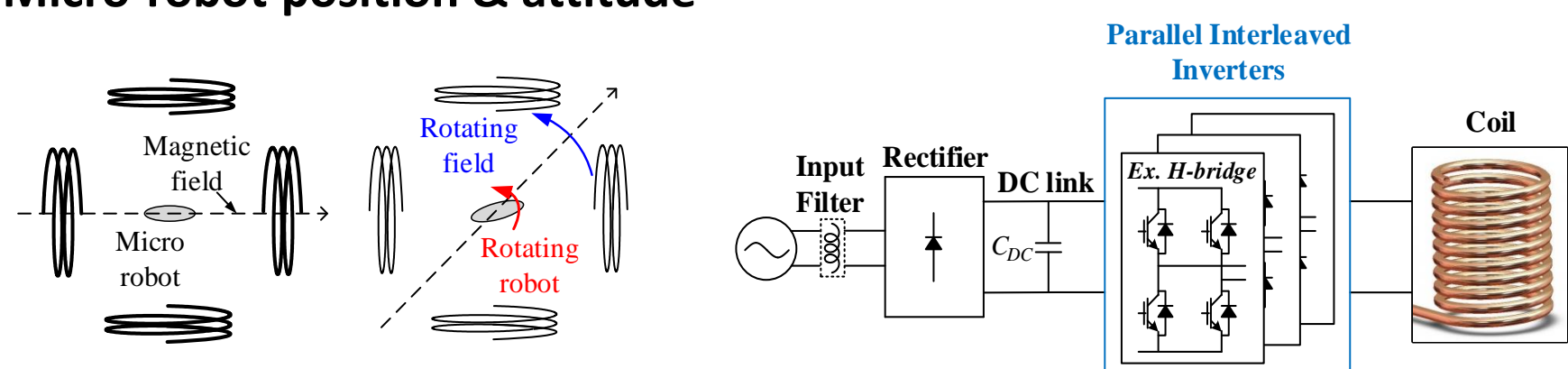
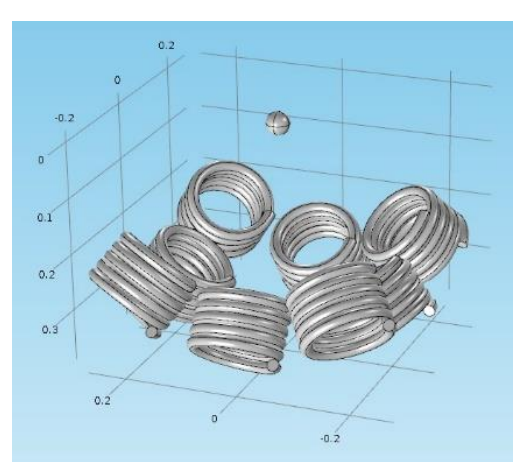
- W/o or w/ a short-circuited q-axis winding
- Reduced costs and devices (vs. 3-phase case)
- Maximum dc link voltage utilization



Micro-robot control

Magnetic Manipulation

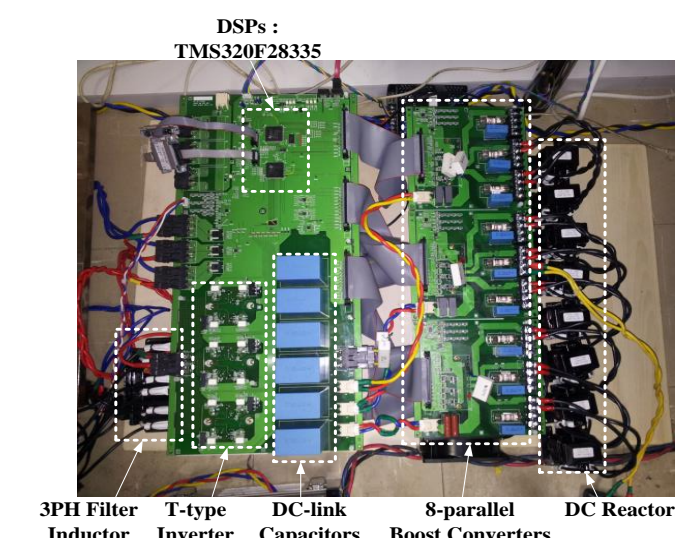
- Magnetic field and its gradient with 8 coils
- Safe actuating circuit
 - Uninterruptable power supply
 - Interleaved inverters
- Control and monitoring by DSP or PC
 - Micro-robot position & attitude



Renewable Energy Conversion

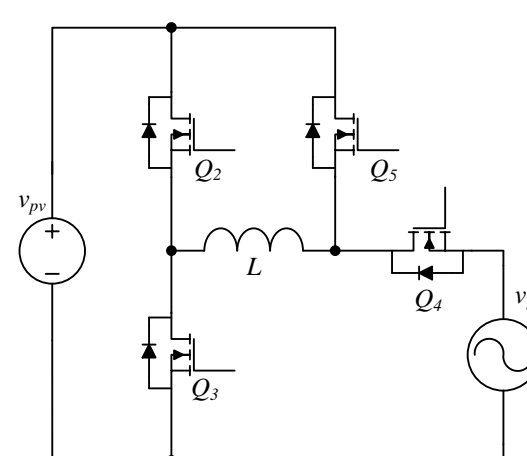
Multi-String PV System

- 8-parallel PV panels
- High power PV converter (~ 10 kW)
- Improving MPPT performance
- Achieving high efficiency



HA Converter

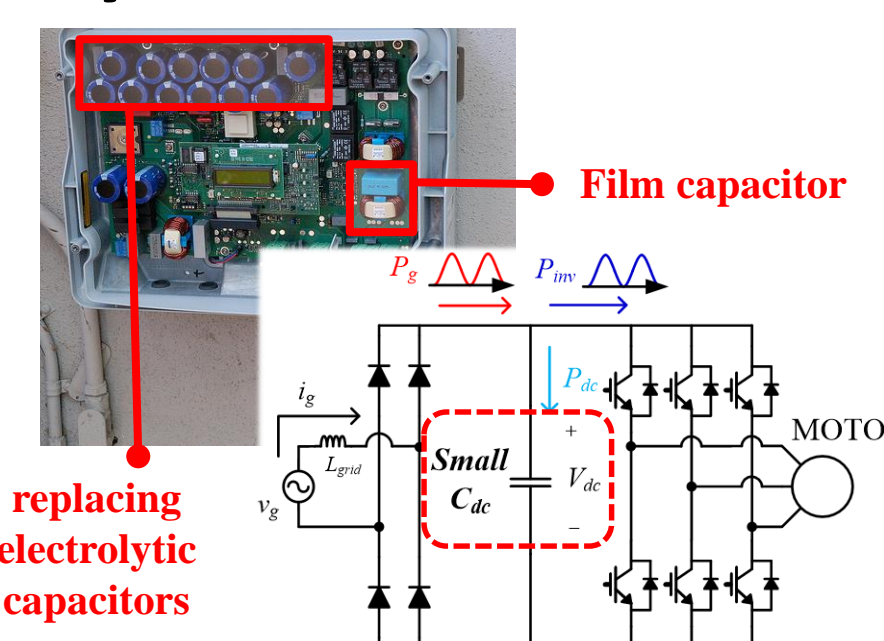
- New topology for PV converter
- Low common-mode voltage
 - Minimizing energy leakage loss
 - Enhancing conversion efficiency



Small-Sized Power Systems

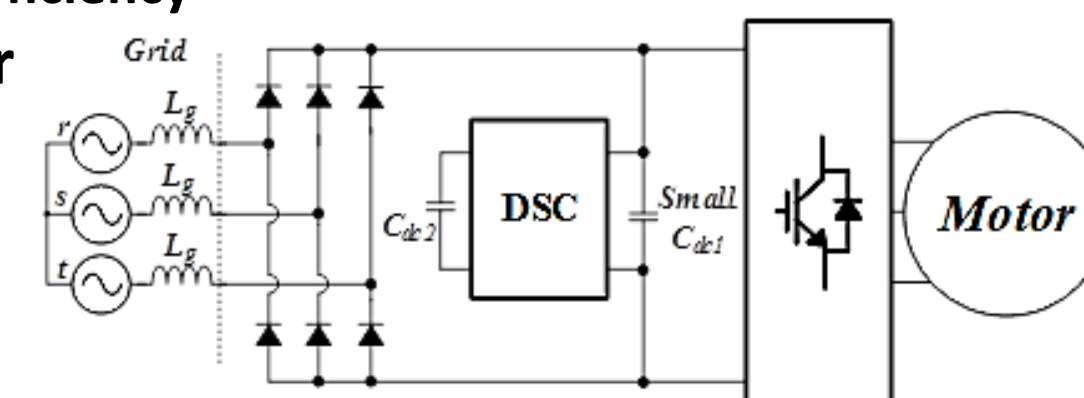
Electrolytic Capacitor-less System

- Reduction of dc-link capacitance
- No electrolytic capacitor
 - ➔ Enhancing system reliability
 - ➔ Using only film capacitors
- Grid current shaping control
- Applications
 - Compressors & pump



DC-link Shunt Compensator (DSC)

- Multi-purpose circuit
 - Miniaturizing capacitor and inductor
 - Enhancing entire system efficiency
- Small-sized film capacitor
- Applications
 - System air conditioner
 - General purpose inverter



High-Frequency DC-DC Converter

- Increasing switching frequency (≥ 1 MHz)
 - ➔ Achieving high power density
 - ➔ Size reduction of passive elements
- GaN switching device
 - Excellent switching performance
 - Suitable for high-frequency operation
- Soft switching techniques
 - Low switching loss by zero voltage switching
- Single-switch resonant converter
 - Simple gate drive circuit
 - Reduced switch voltage stress

