

### Lab Introduction

#### ■ Overview

- Power Electronics Engineering Laboratory
- Lab: Bldg. 301, Rm. 617/8, 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

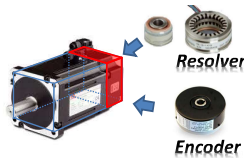
#### ■ Funding



### Motor Control

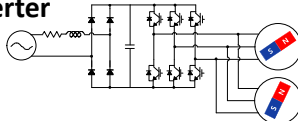
#### ■ Sensorless Control

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



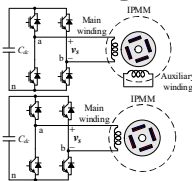
#### ■ Dual Motor Single Inverter

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



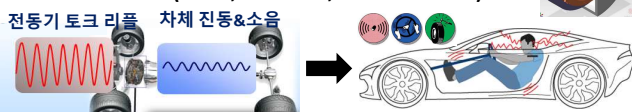
#### ■ Single-Phase Stator Control

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



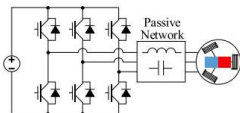
#### ■ Advanced Torque Control for EV Motor

- New model of IPMSM considering slotting effects
- Minimum torque ripple & Minimum current ripple
- Minimum NVH (noise, vibration, and harshness)



#### ■ System with Passive Output Power Network

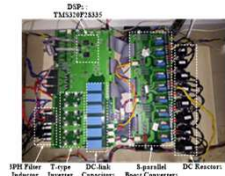
- Passive network between motor and inverter
- Extend operating area
- Reduced costs
  - (Using low voltage devices)



### Renewable Energy Conversion

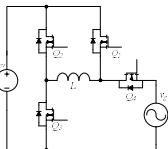
#### ■ Multi-String PV System

- 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



#### ■ Prof. Jung-Ik Ha

Professor at SNU



IEEE Fellow, Vice-President of Korean Institute of Power Electronics  
Editor-in-Chief, Journal of Power Electronics  
Visiting Scholar of Massachusetts Institute of Technology (MIT)  
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:



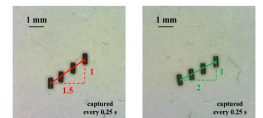
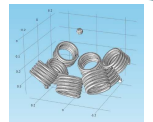
#### ■ Master Candidates:



### Micro-robot control

#### ■ Magnetic Manipulation

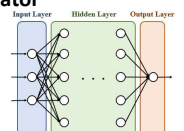
- Magnetic field and its gradient with 8 coils
- Safe actuating circuit
  - Uninterruptable power supply
  - Interleaved inverters
- Control and monitoring by DSP or PC
  - Micro-robot position & attitude



### Machine Learning

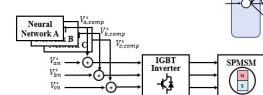
#### ■ Neural Network Nonlinear Model Estimator

- Neural network inverter nonlinearity compensator
- Neural network rotor position estimator
- Temperature estimation of electric machine



#### ■ Iterative Learning Control

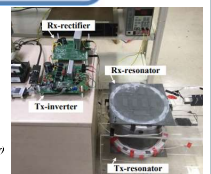
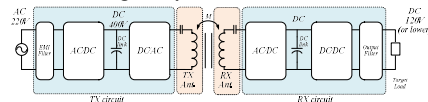
- Torque ripple reduction



### Wireless Power Transfer

#### ■ Inductive Power Transfer

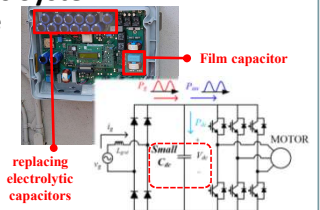
- Transfer power using inductive coil
- Diverse applications
  - Phone charger, Ropeless elevator



### 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



#### ■ High-Frequency DC-DC Converter

- Increasing switching frequency ( $\geq 1$  MHz)
  - ➔ Achieving high power density
- GaN switching device
  - Excellent switching performance
  - Suitable for high-frequency operation
- Soft switching techniques
  - Low switching loss by zero voltage switching

