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Inhwi Hwang

Ph.D. applicant (Fall, 2023)

"From nm to km..."*(An interdisciplinary researcher on power electronics)*

My dream is to be an accomplished and all-rounded power electronics engineer who has a strong understanding from the nano meter scale (semiconductor and material physics level) to the kilo meter scale (power grid level). My character (dedication, passion and growth) and my background (power electronics, materials, and computer science) prove my potential as a promising power electronics engineer. All challenges in Ph.D. course will give me great lessons to develop a higher level!

Education

Master's Degree **Feb 2022**
Electrical and Computer Engineering, Seoul National University (Adviser: Seung-Ki Sul, IEEE Fellow)
- GPA: 4.0/4.0

Bachelor's Degree **Aug 2020**
Electrical and Computer Engineering, Seoul National University (including 2 years for military service, Korea Navy)
- Major: 3.91/4.0, Overall: 3.71/4.0 (advanced GPA after a second year: 3.965/4.0)

Research and Technical Experience

Industrial project: 3.2 kW PFC (power factor correction) in data centers **Jan. 2022 — Feb. 2023**
LG Innotek Co., Ltd. *Seoul, Korea*
- Goal: Improving efficiency of single phase AC-DC converter from 98.8% to 99.0%
- 1. PCB optimization and design of totem-pole PFC with superjunction MOSFET, SiC MOSFET, and GaN devices
- 2. Loss analysis and optimization (inductor, passive filter, and switching devices)
- 3. TCM (triangular current mode) algorithm implementation with variable switching frequency

M.S. thesis: Extending torque operation limit in signal-injection sensorless Control for IPMSM **Sep. 2021 — Nov. 2021**
- Goal: Extending available torque limit in square wave sensorless control
- 1. Implementation of nonlinear control algorithm with data from finite element analysis (Maxwell)
- 2. Automated extraction of flux maps, dynamics inductances, and MTPA of IPMSM

Industrial project: Motor control for vibration reduction in scotch-yoke system **Jan. 2021 — Aug. 2021**
LG Electronics Inc. *Seoul, Korea*
- Goal: Vibration reduction of scotch-yoke system
- 1. Mechanical analysis and motor control in a scotch-yoke system
- 2. Algorithm implementation of load weight estimation from motor stator current
- 3. Vibration and cleaning force optimization with machine learning in real-time

B.S. graduation project: 3-bit optical coding for improving the power of optical computing **Mar. 2020 — Jun. 2020**
- Goal: Extending region of permittivity and permeability from 1D to 2D
- 1. Finite element analysis of fabricated nanomaterials with COMSOL
- 2. Integrated nanomaterials with various geometries

Upcoming projects and researches before Ph.D. **Feb. 2023 — Jul. 2023**
- Industrial project: Integrated AC-DC and DC-DC converter in data center
- Industrial project: IGBT and SiC multi-level modular converter (MMC) control with ether-cat and its hardware design

Publications

Journals

'Enhanced Dynamic Operation of Heavily Saturated IPMSM in Signal-Injection Sensorless Control with Ancillary Reference Frame' (Status: accepted)
Authors: ***Inhwi Hwang****, Yong-Cheol Kwon, Seung-Ki Sul*
IEEE Transactions on Power Electronics (TPEL), 2022

'Analysis of Position Estimation Error in Signal-Injection Sensorless Control Induced by Inverter dv/dt Based Current Measurement Noise' (Status: published)
Authors: Yoon-Ro Lee, Jiwon Yoo, ***Inhwi Hwang****, Seung-Ki Sul*
IEEE Transactions on Power Electronics (TPEL), 2022

'Real Time Temperature Estimation with Electroluminescence Effect of SiC Body Diode in PWM operation of 3 Phase 2 Level Converter' (Status: will be submitted)
Authors: ***Inhwi Hwang****, Jisun Ham, Shenghui Cui*
IEEE Transactions on Power Electronics (TPEL), 2022

'Square Wave Type Signal-Injection Sensorless Operation of Synchronous Motors with Minimum High-Frequency Torque Ripple in Entire Torque Region' (Status: will be submitted)
Authors: ***Inhwi Hwang****, Jiyu Lee, Shenghui Cui*
IEEE Transactions on Industrial Electronics (TIE), 2023

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Conference

'Gain Scheduling of Full-Order Flux Observer for Sensorless PMSM Drives Considering Magnetic Spatial Harmonics' (Status: published)
*Authors: Jiwon Yoo, **Inhwi Hwang**, Yoon-Ro Lee, Seung-Ki Sul*
IEEE Energy Conversion Congression and Expo (ECCE), 2021

'Enhanced Dynamic Operation of Heavily Saturated IPMSM in Signal-Injection Sensorless Control' (Status: oral-presented, published)
*Authors: **Inhwi Hwang**, Yong-Cheol Kwon, Seung-Ki Sul*
IEEE Energy Conversion Congression and Expo (ECCE), 2022

'High Frequency Torque Ripple Mitigation and Available Torque Limit Extension in Signal-Injection Sensorless Control Method'
(Status: digest submitted) *Authors: Jiyu Lee, **Inhwi Hwang (corresponding author)***
International Conference on Power Electronics (ICPE: ECCE-Asia), 2023
Two more papers are being prepared for ECCE 2023 and COMPEL 2023

Patents

Domestic Patents

- *Algorithm for reducing machinery system's vibration of oscillating loads* — Patent Application Number: 1020220023050
- *Motor control method of oscillating load system* — Patent Application Number: 1020220023049

Honors

***Commencement Valedictorian (Graduate Class Representative)** in Seoul National University Graduation Ceremony* — Fall 2020
(Click here for speech video link; 20m 46s)
Academic Scholarship, Kim Jeong-Sik Special Scholarship — Spring 2020

Main Courseworks

Power Electronics and Control Related

- *Electric Machine and Control (Lecturer: Seung-Ki Sul)* — GPA: 4.0/4.0
- *Electric Machine Control Theory (Lecturer: Seung-Ki Sul)* — GPA: 4.0/4.0
- *Power Semiconductor Devices (Lecturer: Shenghui Cui)* — GPA: 4.0/4.0
- *Introduction to Electronic Circuits and Laboratory (Lecturer: Jae-Ha Kim)* — GPA: 4.0/4.0
- *Fundamentals of Control Engineering (Lecturer: Hyung-Bo Shin)* — GPA: 4.0/4.0

Material, Semiconductor and Quantum Physics Related

- *Semiconductor Devices (Lecturer: Hyung-Cheol Shin)* — GPA: 4.0/4.0
- *Nanoelectronic Devices and Quantum Transport (Lecturer: Byung-Gook Park)* — GPA: 4.0/4.0
- *Application of Quantum Mechanics (Lecturer: Namkyoo Park)* — GPA: 4.0/4.0
- *Organic Semiconductor (Lecturer: Jae-Sang Lee)* — GPA: 4.0/4.0
- *Advanced Display Technology (Lecturer: Soo-Yeon Lee)* — GPA: 4.0/4.0
- *Introduction to Quantum Computing and Information (Lecturer: Tae-Hyun Kim)* — GPA: 4.0/4.0
- *Fundamentals of Nanoelectronic Devices (Lecturer: Byung-Gook Park)* — GPA: 4.0/4.0
- *Quantum Physics : Short Course (Lecturer: Gun-Sik Park)* — GPA: 4.0/4.0
- *Introduction to Materials Science and Engineering (Lecturer: Ki-Bum Kim)* — GPA: 4.0/4.0

Computer Science Related

- *Computer Organization (Lecturer: Jung-Ho Ahn)* — GPA: 4.0/4.0
- *Autonomous Robot Intelligence (Lecturer: Sung-Woo Kim)* — GPA: 4.0/4.0
- *Introduction to Random Variables and Random Processes (Lecturer: Wan-Choi)* — GPA: 4.0/4.0

Electromagnetics Related

- *Electro-optics (Lecturer: Yoon-Chan Jung)* — GPA: 4.0/4.0
- *Introduction to Photonics (Lecturer: Jung-Hoon Kwak)* — GPA: 4.0/4.0
- *Introduction to Electromagnetism (Lecturer: Yoon-Chan Jung)* — GPA: 4.0/4.0
- *Electromagnetics (Lecturer: Jae-Sang Lee)* — GPA: 4.0/4.0

(*GPA has been highly improved to an excellent level after a second year of undergraduate)

Skills and Interests

Tools and Languages	Hardware skill(Power board design, Control board design with CPU of DSP, Solidworks), Matlab, Simulink, Plecs, LTSPICE, FPGA, C, Latex, Python(Pytorch), CPLD, Motor system setup, R, Comsol, Maxwell
Current Research Topics	Power factor correction circuit, Sensorless control of electric machine, Electroluminescence effect of SiC
Prospective Interests	Wireless power transfer, DC-DC converter with piezoelectric material, Multi-level resonant converter, Power semiconductor packaging and design, Battery management system