



Muhammad Zarkab Farooqi

Nationality: Indian

Age: 28 Years

Marital status: Single

EMAIL: [Zarkab\[at\]gmail.com](mailto:Zarkab[at]gmail.com), [Zarkab\[at\]ee.iitd.ac.in](mailto:Zarkab[at]ee.iitd.ac.in)
HOME PAGE: <https://zarkab.github.io/>
CONTACT: +91-7006484936
ORCID ID: [0000-0001-9686-322X](https://orcid.org/0000-0001-9686-322X)
WoS ID: [GVU-3424-2022](https://www.scopus.com/authid/detail.uri?authorid=GVU-3424-2022)

I Muhammad Zarkab Farooqi, currently pursuing a doctoral degree from the EE Department at the Indian Institute of Technology (IIT), Delhi. I am part of the PGML Lab, and working under joint supervision of [Prof. Bhim Singh](#) and [Prof. B.K.Panigrahi](#). My specific focus is on pioneering the development of high-power density and high-efficiency-based AC-DC converters in accordance with the Google Little Box Challenge. I have dedicated significant effort to the development of both non-isolated and isolated DC-DC converters, focusing on implementing soft-switching techniques to enhance overall efficiency. Additionally, I have designed integrated EV chargers, which involved combining both the traction and charging infrastructure into a unified entity. I have also put forth a modulation and control technique for these integrated systems to achieve improved performance and validated these advancements using ANSYS MAXWELL. Furthermore, I have developed 1.5kW all SiC MOSFET-based integrated isolated AC-DC-DC converter, dual-active bridge, dual-half bridge, and totem-pole based series-stacked buffer for charging/ discharging a 120V battery using an isolated Gate Driver card operating at 200kHz.

EDUCATION

- [2019(Jan) - 2023(Dec)] Doctor of Philosophy in Electrical Engineering
Department of Electrical Engineering, Indian Institute of Technology, New Delhi, India
Advisors: [Prof. BHIM SINGH](#), [Prof. B.K.PANIGRAHI](#)
Thesis Title: **Improved Power Electronics based Solutions for AC-DC Converters**
CGPA: 8.75/10
- [2014 - 2018] Bachelor of Technology in ELECTRICAL ENGINEERING
Department of Electrical Engineering, National Institute of Technology, Srinagar, India
Advisors: [Dr. TABISH NAZIR MIR](#), [Prof. ABDUL HAMID BHAT](#)
Thesis Title: **Comparative Analysis Of Modulation Strategies For Three-Phase Voltage Source Converters**
CGPA: 8.61/10 (4th Position)

RESEARCH INTERESTS

Integrated Chargers, Wide-bandgap Semiconductor based Soft-switched Converters, Electronic Capacitors (Active Power Buffers), Planer Magnetics, and Advance Control Techniques in PE Converters.

WORK EXPERIENCE

OCT 2021 - DEC 2023	TEACHING ASSISTANT Department of Electrical Engineering IIT Delhi, Delhi, India
DEC 2018 - OCT 2021	RESEARCH FELLOW Department of Science and Technology (DST), and IIT Delhi- (Project Code: RP03631)
AUG 2018 - DEC 2018	ASST. MANAGER Tata Projects Ltd., Telangana, India

TECHNICAL SKILLS

SILICON CARBIDE BASED PE CONVERTERS	<i>Single-phase PFC based AC-DC Converter for bidirectional Power Flow</i> <i>Dual-Active Bridge for EV Charging</i> <i>Power Electronics based Capacitors</i> <i>Soft-switching in DC-DC Converters for Improved Efficiency</i>
GATE DRIVER DESIGN	<i>Gate Driver Design with De-saturation, and Over-current Protection</i> <i>Triggering 5kW SiC based Converter with 100kHz Switching Frequency</i>
DSP, FPGA & DSPACE	<i>Implementation of advance techniques for controlling PE converters</i>
CURRENT/VOLTAGE SENSOR	<i>Sensors with 1MHz bandwidth for controlling PE Converters</i>
MODELLING AND DESIGN	Multiphysics modelling ANSYS MAXWELL, PEMag, RMXprt, Simplorer , Study of EMI and Thermal Issues
CIRCUIT AND PCB	Circuit designing and verification in Simplis, and LT-spice PCB designing in KiCad, Design Spark, and Altium Designer
PROGRAMMING	Proficient in C & Embedded C, Intermediate knowledge of Python

PATENTS

- B. Singh, B.K.Panigrahi **M. Z. Farooqi**, *Single phase single stage isolated bidirectional converter for dc-link capacitor reduction*, Indian Patent Application No. 202111058797.
- B. Singh, B.K.Panigrahi **M. Z. Farooqi**, *Electronic Capacitor based Full-bridge Integrated Isolated DC-DC Converter with Power Decoupling Unfolder Circuit*, Indian Patent (Submitted).

PROFESSIONAL EXPERIENCE

2022-23	<p>DEVELOPMENT OF INTEGRATED-ISOLATED DC-DC CONVERTER-SERB-NSC</p> <ul style="list-style-type: none"> • The development of 0.85 kW based isolated integrated DC-DC converter to reduce the capacitor requirement while delivering desired output power to battery without using any extra switch. • SiC based full-bridge DAB was developed and integrated with a unfolding bridge to perform active power decoupling in multilevel converters, which have applications in ultra-fast EV charging stations, large-scale solar PV systems, railway traction system and split-battery energy storage system. <p>Submitted to IEEE Transactions on Industrial Electronics, IEEE IAS-2023</p>
2020-23	<p>CONTROL AND MODULATION STRATEGIES FOR BUCK-BASED ELECTRONIC CAPACITOR-GoI-DST</p> <ul style="list-style-type: none"> • Developed a control strategy for 1kW SiC based electronic capacitor of which entitles the design of a faster decoupling control in CRM modulation, while ensuring the system stability and efficiency during dynamic periods. • A hybrid continuous and critical conduction mode which minimizes power loss attributed to buck-based electronic capacitor, over a wide power range, making it suitable for high-power applications. The modulation technique was verified by using specially designed low-noise immunity current sensor board integrated with Texas Instruments microcontroller (TMS320f28379D). <p>Published in IEEE Transactions on Industrial Informatics</p>

2021-22	<p>MULTI-FUNCTIONAL INTEGRATED PMSM BASED ON-BOARD CHARGER GoI-DST</p> <ul style="list-style-type: none"> • A higher gravimetric and volumetric power density in the on-board charger was attained by employing an integrating set of components for charging the HV battery, LV battery, and traction purposes. • Components employed for charging a LV battery were reutilized for active power decoupling in grid connected mode. • An improved control and modulation was derived for input power quality and EMI improvement for proposed integrated charger and verified on 1kW hardware prototype.
2020-23	<p>Submitted to IEEE ECCE-2021, IEEE Transactions on Transportation Electrification</p> <p>MENTORING STUDENTS FOR MASTER THESIS AND BACHELOR'S PROJECTS</p> <ul style="list-style-type: none"> • Project 1: Transformer Design using Finite Element Analysis (FEA). • Project 2: Control and Design of high frequency unfolded based isolated DC-DC converters. • Project 3: Planar Inductor Design using ANSYS MAXWELL. • Project 4: Single-stage isolated AC-DC converters for railway traction application
2017-18	<p>COMPARISON OF DIFFERENT MODULATION STRATEGIES FOR 3-PHASE VOLTAGE SOURCE CONVERTER PE Lab, NIT Srinagar</p> <ul style="list-style-type: none"> • Various modulation techniques of a three-phase voltage source converter were compared, analyzed and examined for their performance in generation for a sinusoidal output. Modulation techniques include Sine-PWM, Space-vector PWM, Delta-Sigma, Model Predictive Control and Modulated Model Predictive Control. • MATLAB/Simulink and Hardware implementation of different modulation techniques was verified on 1kW IGBT based 3-Phase VSI using D-Space(RTI 1104)

INDIVIDUAL PROJECTS

- DESIGN AND ANALYSIS OF NON-LINEAR PLANAR INDUCTOR USING ANSYS MAXWELL AND KICAD
- DESIGN OF ISOLATION TRANSFORMER FOR FLYBACK CONVERTER USING ANSYS MAXWELL (PE-MAG)
- DESIGN OF 100kW IPMSM USING ANSYS MAXWELL (RMXPRT)
- 1 kW SiC BASED DUAL-ACTIVE BRIDGE FOR CHARGING A 120V, 24AHR BATTERY

PUBLICATIONS

Selected Publications

- [J1] **M. Z. Farooqi**, Bhim Singh, B. K. Panigrahi, "Robust Control for Enhanced Dynamic Performance of CRM based Active Power Decoupling Circuit," in *IEEE Transactions on Industrial Informatics*, Early Access (**IF:12.3**). [Link](#)
- [J2] **M. Z. Farooqi**, Bhim Singh, B. K. Panigrahi, "Reduced Sensor-Based Model Predictive Control of Power Decoupling Circuit for On-Board EV Charger," in *IEEE Transactions on Transportation Electrification*, vol. 9, no. 2, pp. 2104-2114, June 2023. (**IF:7.0**). [Link](#)

Journal papers

- [J3] **M. Z. Farooqi**, Bhim Singh, B. K. Panigrahi, "Enhanced Control and Modulation of On-Board Integrated EV Charger with Active Power Decoupling Capability," in *IEEE Transactions on Transportation Electrification*. (**IF:7.0**)(Under Review: TTE-Reg-2023-03-0514.R1)
- [J4] **M. Z. Farooqi**, Bhim Singh, B. K. Panigrahi, "Integrated Electronic Capacitors based Split BES-assisted Modular Multi-Port Power Electronic Transformer for Fast EV Charging Station,"

Conferences Papers

- [C1] **M. Z. Farooqi**, Bhim Singh, B. K. Panigrahi, Rohit Kumar, “Single-Stage Isolated Bidirectional Soft-Switched AC-to-DC Converter with Active Power Decoupling,” in *14th IEEE Energy Conversion Congress and Exposition (ECCE)*, Nashville, TN, USA, 2023, (Accepted-Oral Presentation).
- [C2] **M. Z. Farooqi**, Bhim Singh, B. K. Panigrahi, Rohit Kumar, “Active Power Decoupling in Cascaded H-Bridge Converter using Secondary-Stage Isolated DC-DC Converters,” in *IEEE IAS Annual Meeting 2023 (IASAM)*, Omni Nashville, TN, USA, 2023, (Accepted-Oral Presentation).

TEACHING EXPERIENCE

- Introduction to Electrical Engineering (ELL101)
- Introduction to Electrical Engineering Lab (ELP101)
- Electromechanics Laboratory Lab (ELP203)
- Electrical Machines Lab (ELP850)

TALKS AND SEMINARS

- Oct, 2023 *Poster Presentation at IEEE IAS-AM 2023* on Integrated-Isolated Electronic Capacitor for DC-DC Power Conversion in Multi-level AC-DC-DC Converters.
- April, 2023 *Invited talk at JNTU, Kakinada, AP* on Implementation and Design of Isolated DC-DC Converters.
- Feb, 2023 *Invited talk at JNTU, Kakinada, AP* on Design and Implementation of Digital Controller for DC-DC & AC-DC Converters.
- Oct, 2022 *Invited talk at NITTTR, Chandigarh* on Control and Stability Analysis of Switched Mode Power Converters.
- Oct, 2021 *Paper Presentation at IEEE ECCE-US 2021* on Reducing DC-Link Capacitance in EV Chargers.
- May, 2021 *Paper Presentation at IEEE ECCE-Asia 2021* on Isolated Multilevel EV Chargers.
- Dec, 2020 *Paper Presentation at IEEE PEDES 2020* on Model Predictive Control in Multilevel EV Chargers.

AWARDS AND CERTIFICATES

- 2023 *Graduate Student Grant* in IEEE Industry Applications Society (IAS) Annual Meeting 2023.
- 2023 *Research Excellence Travel award (RETA)* in IIT Delhi-2023.
- 2021 *Research Scholar Travel Award (RSTA)* in IIT Delhi-2021.
- 2018 *4th Rank* in the class of 75 students (B.Tech) in NIT Srinagar-2018.
- 2023 *Ansyz Maxwell: High Frequency Power Magnetics* by Udemy (Online)

REFERENCES

- **Prof. Bhim Singh (Ph.D. Supervisor)**
[bsingh\[at\]ee.iitd.ac.in](mailto:bsingh[at]ee.iitd.ac.in)
Department of Electrical Engineering
Indian Institute of Technology Delhi, India
- **Prof. Bijaya Ketan Panigrahi (Ph.D. Supervisor)**
[bkpanigrahi\[at\]ee.iitd.ac.in](mailto:bkpanigrahi[at]ee.iitd.ac.in)
HOD, Centre for Automotive Research and Tribology
Indian Institute of Technology Delhi, India
- **Dr. Tabish Nazir Mir (B.Tech Supervisor)**
[Tabish.Mir\[at\]nottingham.ac.uk](mailto:Tabish.Mir[at]nottingham.ac.uk)
Department of Electrical and Electronic Engineering
University of Nottingham, United Kingdom