Dr. Surja Sekhar Chakraborty

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Work Experience

- **Assistant Professor** **(Oct, 2024-Present)**
  National Institute of Technology Rourkela
- **Manager R&D Power Electronics** **(June, 2023-Sept. 2024)**
  Schneider Electric India Pvt. Ltd.
  - Developed working prototype of a 6A, 240V AC solid state circuit breaker.

Education

- **M.S + Ph.D in Electrical Engineering (Power Electronics)**
  Indian Institute of Technology Madras (IITM), Chennai, India *2016-2023*
- **B.E in Electrical Engineering**
  Indian Institute of Engineering Science and Technology (IIEST), Shibpur, India *2011-2015*

Key Projects

PhD Research Project:

1. **Design and Control of Multi-port Isolated DC-DC Series Resonant Converter**
   - Developed an accurate small signal model which can predict both low frequency and high frequency dynamics of an isolated DC-DC series resonant converter.
   - Designed multivariable state-feedback control system to achieve high efficiency and wide voltage conversion ratio for isolated DC-DC series resonant converter.
   - Designed a three-winding high-frequency transformer for multi-port charging application.
2. **Design of Passive Filter for Solid State Transformer**
   - Developed a dynamic equivalent model of a solid state transformer (SST).
   - Designed a passive filter (L & C) at LV DC bus to minimize 100Hz oscillation in the DC-DC stage of the solid state transformer.

Funded Project:

1. **Development of a prototype metal air battery driven electrical drive for a city bus duty**
   Under the scheme of Impacting Research Innovation and Technology (IMPRINT-2), GOI.
   Industry partner: Ashok Leyland
   - Developed a hardware prototype of 48V/48V/400V, 750W 3-port DC-DC converter.
   - Developed a control algorithm for bidirectional power flow control.
2. **Hardware Development and Control Implementation of a Solid State Transformer (SST)**
   Under the scheme of Indo-German Centre for Sustainability (IGCS), IITM.
   Industry partner: Maschinenfabrik Reinhausen, Germany
   - Designed the hardware architecture of a **3-phase, 1.65kV/300V, 20kVA** Solid State Transformer (SST)
   - Selected components such as SiC MOSFETs, Gate Driver ICs, Sensors, Heatsinks, DC link capacitros, Snubber capacitors, Filter inductors, Breaker and Isolater for the hardware prototype.
   - Designed the PCB-layout of SiC-MOSFET (TO-247-4L) based H-bridge and 2-Level VSI with very low DC bus stray inductance ($\approx$ 50nH).

Technical Skills

Hardware:

- Hardware design, testing and troubleshooting of AC-DC, DC-DC (Resonant Converter) and DC-AC converters
- Design of heat sinks, PCB-layout for power converters, gate driver circuit, CPLD-based protection circuit
- Passive filter design with inductor and capacitors
- Design of high frequency magnetics
- Small signal modeling and closed loop control implementation of bidirectional series resonant converter

Firmware:

- Embedded C coding for C2000 32-bit Microcontroller (TMS320F28335, *Texas Instruments*)
- Block diagram or schematic based programming in Quartus software for *Altera* FPGA/CPLD.

Software:

- Altium PCB Designer, Ansys Electronics Desktop, Quartus (FPGA), Code Composer Studio (DSP)
- PLECS, MATLAB, LT Spice, PSpice, TINA-TI

Publications

Journals

[1] **S. S. Chakraborty** and K. Hatua, "Modeling with Beat Frequency Dynamics and Phase-Frequency Control Design for a Dual-Bridge Series Resonant Converter," in IEEE Transactions on Industrial Electronics, vol. 69, no. 8, pp. 7952-7962, Aug. 2022, doi: 10.1109/TIE.2021.3109532.

[2] **S. S. Chakraborty**, *et al.*, "Minimization of Low Frequency Current Oscillation in Resonant Link of a Solid State Transformer by Passive Filters," in IEEE Transactions on Industry Applications, 2022.

[3] **S. S. Chakraborty**, *et al.*, "A Control Method to Reduce Overshoots in High-Frequency Link Current and Voltages at Load Transients of a Dual-Active-Bridge Series-Resonant Converter," in IEEE Journal of Emerging and Selected Topics in Industrial Electronics, vol. 4, no. 2, pp. 525-537, April 2023, doi: 10.1109/JESTIE.2023.3243844.

[4] **S. S. Chakraborty**, *et al.*, "Design of a Three-Winding Transformer for Power Decoupling of a Three-Port Series Resonant Converter for an Integrated On-Board EV Charger," in IEEE Transactions on Power Electronics, vol. 38, no. 11, pp. 14262-14273, Nov. 2023, doi: 10.1109/TPEL.2023.3308776.

[5] S. Bhawal, **S. S. Chakraborty** and K. Hatua, "Dynamic Modeling and Closed Loop Control of a Solid State Transformer (SST) based on Series Resonant Converter (SRC)," in IEEE Journal of Emerging and Selected Topics in Power Electronics, doi: 10.1109/JESTPE.2021.3088238.

Conferences

[1] **S. S. Chakraborty**, *et al.*, "Minimization of Low Frequency Current Oscillation in Resonant Link of a Solid State Transformer by Passive Filters," 2022 IEEE International Conference on Power Electronics, Smart Grid, and Renewable Energy (PESGRE), 2022, pp. 1-6, doi: 10.1109/PESGRE52268.2022.9715873.

[2] **S. S. Chakraborty**, *et al.*, "Selection Procedure of Resonant Tank Parameters for an SiC MOSFET based DC/DC Series Resonant Converter," 2018 IEEE International Conference on Power Electronics, Drives and Energy Systems (PEDES), 2018, pp. 1-5, doi: 10.1109/PEDES.2018.8707532.

[3] **S. S. Chakraborty**, *et al.*, "Design of an Isolated Gate Driver for Medium Voltage Cascaded H-Bridge (CHB) Based Solid State Transformer (SST)," 2022 IEEE Global Conference on Computing, Power and Communication Technologies (GlobConPT), New Delhi, India, 2022, pp. 1-6, doi: 10.1109/GlobConPT57482.2022.9938157.

[4] S. Dey, **S. S. Chakraborty**, and K. Hatua, "Design of High Frequency Transformer for a Dual Active Bridge (DAB) Converter," 2022 IEEE Global Conference on Computing, Power and Communication Technologies (GlobConPT), New Delhi, India, 2022, pp. 1-6, doi: 10.1109/GlobConPT57482.2022.9938249.

[5] O. Bhakare, K. Ghosh, **S. S. Chakraborty** and K. Hatua, "Experimental Study and Comparison of Switching Loss Behavior of Si IGBT and SiC MOSFET in Dual Active Bridge Series Resonant Converter," 2023 IEEE International Conference on Environment and Electrical Engineering and 2023 IEEE Industrial and Commercial Power Systems Europe (EEEIC / I&CPS Europe), Madrid, Spain, 2023, pp. 1-6, doi: 10.1109/EEEIC/ICPSEurope57605.2023.10194837.

Training and Workshops

1. **EV Technology and Public Charging Station:** A 5-day online program organized by NIELIT, Calicut. The topics covered are Motors, Batteries, Converter, Inverter, Controls & Controllers in EV, Charging technologies in EV, Public Charging station, Future Trends in Electric Cars.
2. **Resonant Converters and Applications:** A 5-day workshop organized by NIT Warangal. The topics covered are DC-DC resonant power converters for grid integration of renewable energy sources, grid fed LED drivers for lighting applications, bi-directional converter with voltage clamping technique, resonant inverters for welding applications.

Awards and Recognitions

- Received **Best Paper Award** in IEEE 4th International Conference on Sustainable Energy and Future Electric Transportation (SEFET).
- Received **Institute Research Award** for Excellent PhD Works at IIT Madras.
- Received **First Class with Honours** in B.E. from IIEST Shibpur.
- Bagged **1st position** in 'Junkyard' competition in INSTRUO'13 (tech. fest IIEST Shibpur)
- Honoured with **'Amul Vidya Bhushan'** by Amul, Gujarat for 1st Class in 12th standard.

Professional Services & Other Engagements

- Served as a journal manuscript reviewer for IEEE Transaction on Industrial Electronics, IEEE Transaction on Power Electronics, IEEE Journal of Emerging and Selected Topics in Power Electronics.
- Volunteered Vivekananda Study Circle, IIT Madras, a student body focusing on 'Character Building Through Nation Building', during 2018-2022. Coordinated a team of around 10 volunteers for a project to provide free tuition to the underprivileged students in a village called 'Meyyur', around 70kM from Chennai, India.
- Served as the secretary of Vivekananda Youth Circle, IIEST Shibpur, a student organization to provide platform to study and implement the teachings of Swami Vivekananda in ones life, during 2013-2015 and was actively involved in the service activity to the 'Birhor' tribes in Jharkhand, India.