Resume of **Santanu Kapat, Ph.D.**

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Google Scholar page **Scopus page** **Researchgate page** **LinkedIn page**

PROFESSIONAL EXPERIENCE

- June 2025 (1 month): **Visiting Professor, National Yang Ming Chiao Tung University (NYCU), Taiwan**
- May – July 2024 (2 months): **Visiting Professor, University of Illinois at Urbana-Champaign, USA**
- May – June 2023: (1 month): **Visiting International Faculty**, **University of Padova, Italy**
- Sept. 2023 – present: **Professor**, Dept. of Electrical Engineering, **IIT Kharagpur**
- Dec. 2019 – Sept. 2023: **Associate Professor**, Dept. of Electrical Engineering, **IIT Kharagpur**
- Jul. 2019 – Nov. 2019: **Associate Professor**, Dept. of Electrical Engineering, **IIT Delhi**
- Mar. 2018 – Jul. 2019: **Associate Professor**, Dept. of Electrical Engineering, **IIT Kharagpur**
- Aug. 2011 – Mar. 2018**:** **Assistant Professor**, Dept. of Electrical Engineering, **IIT Kharagpur**
- Aug. 2010 – Aug. 2011: **Research Engineer**, **GE Global Research**, Bangalore, India
- Aug. 2009 – Jul. 2010: **Visiting Scholar**: Dept. of ECE, **University of Illinois (UIUC),** USA

EDUCATION

- **Ph.D.** Electrical Engineering IIT Kharagpur 2010
- **M.Tech.** Electrical Engineering IIT Kharagpur 2006
- **B.E.** Instrumentation Technology VTU, Belgaum 2003

AWARDS/RECOGNITIONS

- ***Industry awards***: **MathWorks** Research Award in 2024, **Qualcomm Faculty Award** in 2022 from Qualcomm
- ***Global recognition***: **Among the top 2% of Global Scientists** (both in career-long and single-year categories) in Electrical and Electronics Engineering (prepared by Stanford University)**, 2020, 2021, 2022, 2023, 2024, 2025;** Visiting international faculty at the University of Padova in 2023 under the "**Shaping a World-Class University**" initiative.
- ***Footprint in IEEE APEC (top IEEE PELS conference)***: a) Highest no. of papers (9) in ***APEC 2022*** worldwide (jointly with Virginia Tech, USA), b) 49 papers in ***IEEE APEC***, c) 2 ***APEC*** outstanding presentation awards in 2019.
- ***Global outreach***: Offered short courses on ***Digital Control in Power Management Converters*** at the a) National Yang Ming Chiao Tung University (NYCU), Taiwan (June 2025), b) University of Illinois at Urbana-Champaign, USA (from May to July 2024), and c) University of Padova, Italy (from May to June, 2023); presented tutorials/seminars

on ***High Performance Digital Control*** at the d) National Cheng Kung University (NCKU), Taiwan, on June 4, 2025, e) University of Arkansas, USA on May 31, 2024, and f) RWTH Aachen University, Germany on June 2, 2023.

- ***Awards in India***: a) **Faculty Excellence Award,** IIT Kharagpur, **2022,** b) **INSA Medal for Young Scientist** in 2016 from the Indian National Science Academy; c) **INAE Young Engineering Award** in 2016 from the Indian National Academy of Engineering; d) **DAE Young Scientist Research Award** in 2014
- ***IEEE Power Electronics Society (PELS)***: 2 Invited Webinars from IEEE PELS, a) Fixed and Variable Frequency Digital Control Architectures in Switched Mode Power Converters and FPGA-based Prototyping in Jan. 2023, b) Online Pedagogical Resources on Control and Tuning Methods in Switched Mode Power Converters in Dec. 2021.
- ***Tutorial/short-courses in IEEE conferences:*** a) **3-hour short-term course** (jointly presented with Prof. Philip Krein, UIUC) at ***IEEE ITEC* 2024**, Chicago, USA, June 2024, **Invited tutorial speaker** at b) ***IEEE INTELEC*** *2024* in Bangalore, India, Aug. 2024, and c) ***IEEE PESGRE*** *2023* in Trivandrum, India, December 2023, and d) ***IEEE PELS*** Summer School conducted by IIT Bhubaneswar and *IEEE PELS*, Bhubaneswar, India, July 2023.
- ***IEEE Editorial Activities***: **Associate Editor** of a) *IEEE Transactions on Power Electronics* since 2015 onward, b) *IEEE Journal of Emerging and Selected Topics in Power Electronics* from 2020 to 2025, c) *IEEE Open Journal of Power Electronics* from 2024 onward, and d) *IEEE Transactions on Circuits and Systems II: Express Briefs* from 2018 to 2023

MAJOR VERTICALS of CONTRIBUTIONS

[1] Major Scientific Contributions – a summary of contributions is presented later
[2] Technology and IP Development – a list of new technologies and IP developments is presented later
[3] New Labs and Facilities Development – a list of initiatives and lab development is presented later
[4] New Hands-on Courses and Program Development – a list of new courses/programs is presented later
[5] Skilled Manpower Development – a list of contributions in this vertical is presented later
[6] Development of Pedagogical Resources and Training Programs – details are summarized later

MAJOR SCIENTIFIC CONTRIBUTIONS

[1] Developed a unified discrete-time modeling framework and solved an open problem: This is a fundamental contribution, and the framework is the basis tool for deriving large-signal and small-signal models of flying capacitor multilevel converters and other hybrid switch capacitors and resonant switching converters, which can be extended to all classes of switching converters. The technique can enable the development of ultra-fast digital control solutions for powering AI servers, data centers, automotive, and other emerging applications.

[2] Developed large-signal controlled design techniques in fixed/variable-frequency digital current/voltage control techniques. This is a unique contribution that replaces existing small-signal-based designs, enabling designers to achieve ultra-fast transient performance in almost all classes of buck, boost, and buck-boost derived converters.

[3] Developed theories for uniform and event-based sampling for fixed and variable frequency digital control. These are powerful tools for developing high-performance resource-optimized digital/mixed-signal integrated power management converters and GaN-based co-packaged optimized power modules with smaller form factors.

[4] Developed accurate and scalable modeling and network partitioning techniques for fast controller hardware-in-loop (CHIL) and power HIL simulation of high-frequency and complex switching power converters: This is a powerful tool to devise/design/validate digital power solutions with ultra-fast start-up and transient performance under current limits, EMI reduction, fault-tolerant, power sequencing, hot swapping, and other features.

[5] Identified the effect of sampling delay and quantization in DC-DC converters under fixed and variable frequency digital control techniques. It is reported for the first time that the sampling delay can lead to undesirable non-linear phenomena that may result in much higher RMS current and voltage ripple, which was not explored earlier.

[6] Developed a theoretical basis for spectral shaping for EMI reduction with insignificant impacts on performance and ripple parameters in digitally controlled power management converters. This may help reduce the EMI filter size, yet achieve fast transient performance and high efficiency in automotive, space, UAV, and server applications.

MAJOR TECHNOLOGIES DEVELOPED

[1] Power converter architectures and digital control solutions with ultra-fast dynamic voltage scaling (DVS) transient performance for multi-core processors and envelope tracking power amplifiers

[2] Scalable two-stage cascaded architectures for 48V-to-PoL (point of load) with ultra-fast transient response and high efficiency, particularly suited for AI server power supply, integrated voltage regulators, automotive, etc.

[3] Fixed and adaptive on-time digital voltage control architectures for ultra-fast transient response in scalable multiphase voltage regulators, as well as scalable multi-module series capacitor multiphase buck voltage regulators for AI and cloud servers, integrated voltage regulators for vertical power delivery, and automotive computing

[4] Fixed and adaptive on-time digital and mixed-signal current control architectures for ultra-fast transient response in scalable multiphase voltage regulators, as well as scalable multi-module series capacitor multiphase buck voltage regulators for AI and cloud servers, integrated voltage regulators, automotive, and high-performance computing

[5] Model-based digital control architectures for high-frequency integrated power management and system-level power solutions with ultra-fast transient, high efficiency, and improved EMI with the scalability feature

[6] Ripple-based scalable digital/mixed-signal architectures for scalable integrated voltage regulators, GaN-based scalable digital power modules for 48V AI servers, cloud computing, and automotive computing applications

[7] A new discrete-time solver and fast/accurate software-in-loop and FPGA-based HIL simulators for rapid prototyping and validation of high-frequency, complex power electronics converters, including modern hybrid switched-capacitor and resonant converters. The simulator is scalable with accurate network partitioning features to accelerate HIL simulation using resource-optimized interleaved hardware and multi-core parallel hardware. It can break the speed and accuracy benchmarks of leading commercially available HIL simulators.

[8] Fixed/variable-frequency digital/mixed-signal controllers in traditional, hybrid, and resonant power converters

[9] Spectral spreading digital/mixed-signal controllers for EMI reduction with high performance and efficiency

[10] High-performance analog and mixed-signal controllers for multi-channel power management converters

[11] High-performance power converters and control for LED drivers, DVS, 48V automotive, and cloud servers

LAB DEVELOPMENT INITIATIVES

[1] Developed "Embedded Power Management (EPM) Lab" in 2014 in the Department of Electrical Engineering, IIT Kharagpur. This lab was the first of its kind in India, with modern experimental facilities and simulation tools, in carrying out unique high-performance power management research and development activities that are benefiting research students in leading global universities and industry R&D and product development. As part of the above lab, I have (a) imparted unique R&D/hardware/software skillsets among my research students, (b) developed two online courses and many pedagogical resources that are unique and essential in building strong fundamentals on power management converters, modeling and control techniques, digital control architectures, Verilog HDL programming, and FPGA prototyping, and (c) offered many industry advanced training programs.

[2] TEAM LEAD to develop "Electronics-based Design Innovation and Prototyping" (EDIP) lab in 2025, a new and unique initiative at IIT Kharagpur for developing industry-relevant hardware/firmware/hands-on skillset for our students, as well as students from leading academic institutes worldwide. As part of this initiative, (a) two hands-on electives have been developed for undergraduate and postgraduate students, which are unique at IIT Kharagpur, (b) a new industry-academic program, namely Texas Instruments (TI) Scholar Program, has been initiated (officially approved from TI side, which is under administrative processing at IIT Kharagpur) for final year Master's students, which is introduced for the first-time at IIT Kharagpur.

NEW HANDS-ON COURSES AND PROGRAM DEVELOPMENT

[1] Team lead to develop a hands-on undergraduate elective, namely "Electronic System Design" in 2025 in the Department of Electrical Engineering, IIT Kharagpur. This elective covers theory and hands-on exercises together and is aimed at correlating theoretical concepts with experiments and developing project-based learning with interdisciplinary skillsets. It is intended to connect various concepts in analog/digital/mixed-signal circuits, signals, and systems, control systems, digital design/synthesis of fixed-point ALU, HDL programming, etc.

[2] Team lead to develop a hands-on postgraduate elective, "Electronic System Development and Prototyping" in 2025 in the Department of Electrical Engineering, IIT Kharagpur. This elective covers theory and hands-on exercises together and is aimed at correlating theoretical concepts with experiments and developing project-based learning with interdisciplinary skillsets. It is aimed to connect various concepts in analog/digital VLSI, electronic system development, control systems, digital signal processing, digital design/synthesis of fixed-point arithmetic, Verilog HDL programming, and FPGA-based rapid prototyping.

[3] Program Manager, to start a new **Texas Instruments (TI) Scholar Program**, first time at IIT Kharagpur, for selected final year Master's students in the Department of Electrical Engineering. This is a unique academic-industry collaboration model at IIT Kharagpur, where the selected students will get a high-value fellowship during their project year and carry out M.Tech projects in solving industry-relevant open problems.

SKILLED MANPOWER DEVELOPMENT

[1] PhD student guidance: I have guided so far 8 PhD students, out of which 6 students have successfully defended their PhD thesis, 1 student has submitted his PhD thesis, and 1 student has submitted the synopsis report (he has joined Texas Instruments in June 2025 and will submit his PhD thesis by August/September 2025). Presently, I am supervising 7 PhD students at IIT Kharagpur and 1 PhD student at IIT Delhi.

[2] M.Tech student guidance: I have guided more than 30 regular and dual degree M.Tech students. Presently, I am supervising 9 M.Tech students with 6 regular M.Tech students and 3 dual degree M.Tech students.

[3] MS (by research guidance) student guidance: I have guided so far 3 MS students.

[4] B.Tech project guidance: I have supervised more than 30 B.Tech projects.

[5] Skillset development for industry professionals: I have offered many advanced training programs, short courses, and tutorials for leading industries, such as Qualcomm, STMicroelectronics, Texas Instruments, HCL, and NXP.

DETAILS of PhD STUDENT GUIDANCE

Sl. No.	Student Name	Present Organization	Joining Year	Status
1.	Bipin Chandra Mandi	Faculty member, **IIIT Naya Raipur**	Autumn 2011	**Degree awarded**
2.	Amit Kumar Singha	Faculty member, **IIT Mandi**	Autumn 2012	**Degree awarded**
3.	Vedula Inder Kumar	ABB Corporate Research, USA	Autumn 2014	**Degree awarded**
4.	K. Hariharan	Tata Elxsi, UK	Spring 2013	**Degree awarded**
5.	Rabishankar Roy	GE Vernova, Bangalore, India	Autumn 2015	**Degree awarded**
6.	Somnath Khatua	Texas Instruments, Bangalore, India	Autumn 2015	**Degree awarded**
7.	Prantik Majumdar	Texas Instruments, Bangalore, India	Spring 2017	**Synopsis submitted**
8.	Ruturaj Garnayak	Bajaj Auto R&D, Pune, India	Spring 2017	**Submitted thesis**
9.	Dipayan Chatterjee	Research Scholar, IIT Kharagpur	Spring 2019	**To submit thesis** by 2026
10.	Anirban Nanda	Research Scholar, IIT Kharagpur	Autumn 2020	**To submit thesis** by 2026
11.	Faraz Ahmad	Research Scholar, IIT Kharagpur	Spring 2020	**To submit thesis** by 2027
12.	Teja Golla	PMRF fellow, IIT Kharagpur	Autumn 2021	**To submit thesis** by 2026
13.	Calvin Paul	PMRF fellow, IIT Kharagpur	Autumn 2022	**To submit thesis** by 2027
14.	Arindam Maulik	Research Scholar, IIT Kharagpur	Autumn 2023	**To submit thesis** by 2027
15.	Pramit Banerjee	Research Scholar, IIT Kharagpur	Autumn 2025	**Started PhD** from July 2025

PEDAGOGICAL RESOURCE DEVELOPMENT

[1] **Developed an Online (NPTEL) certification course on** "Control and Tuning Methods in Switched Mode Power Converters" in **2021,** which is available on YouTube. This is a ***unique course and also the only online course available*** to date covering the following fundamental topics and differentiating features.

- **a)** This is a unique course, consisting of 60 lectures with a total duration of more than 40 hours.
- **b)** It covers classical PWM control and modern ripple-based control techniques for wide load current ranges, and their link with commercial products, along with customized model development for simulation.
- **c)** It presents small-signal and large-signal modeling techniques and steps for model validation with switch simulation
- **d)** It presents step-by-step guidelines for controller design using traditional small-signal models for buck and boost derived power management converters under voltage mode and current mode control techniques.
- **e)** It presents step-by-step guidelines for controller design using modern large-signal models for ultra-fast transient response in buck and boost-derived power converters using voltage and current-based control techniques.
- **f)** It presents detailed steps from scratch in developing interactive and customized power stage and controller models for software-in-loop simulation using MATLAB for rapid development and functional verification of traditional and advanced PWM and ripple-based control techniques in power management converters.
- **g)** It presents a detailed comparative study of fixed-frequency and ripple-based control techniques, in terms of transient response, ripple parameters, and other features for a wide range of load current and input voltage.
- **h)** It also presents popular light load control techniques, such as PFM, pulse skipping, and burst mode control.
- **i)** Finally, it presents the performance limits in voltage regulators for dynamic voltage scaling applications.

[2] **Developed an Online (NPTEL) certification course on** "Digital Control of Switched Mode Power Converters and FPGA-based Prototyping" in 2022, which is available on YouTube. This is a ***unique course and also the only online course available*** to date covering the following fundamental topics and differentiating features.

- **a)** This is a unique course, consisting of 120 lectures with a total duration of more than 40 hours.
- **b)** Modern trends of digitization in integrated and system-level power management solutions, along with discussions on some digital power converters and commercial solutions
- **c)** Basics of sampling and quantization in digital control systems, along with the fundamentals of uniform and event-based sampling techniques in digitally controlled power management converters
- **d)** Architectures of digital pulse width modulators (DPWM), including counter-based DPWM, delay-line DPWM, and hybrid DPWM architectures, and their advantages and shortcomings
- **e)** Digital and mixed-signal control architectures using fixed-frequency and ripple-based control techniques and their link to some commercial digital power products
- **f)** Step-by-step guidelines for developing custom and interactive models for software-in-loop simulation for digitally controlled power management converters with fixed/variable frequency control, uniform/event-based sampling
- **g)** Concept of Q format in 2's complement and detailed steps for fixed-point implementation with optimized hardware resources and perspectives of digital VLSI design

h) Identifying various digital control platforms, such as ASIC, microcontrollers, FPGA, etc., and their fundamental differences in terms of optimized application-specific hardware vs reconfigurable hardware

i) Verilog HDL programming and writing HDL codes from digital circuit perspectives

j) Detailed architectures and step-by-step Verilog HDL code writing, along with FPGA prototyping/demonstrations of various popular digital/mixed-signal voltage mode and current mode controllers, constant/adaptive on-time digital controllers, and multi-mode digital control for wide operating ranges, including light load control methods

k) Numerous design and Verilog HDL case studies and experimental demonstration of fixed and adaptive on-time digital voltage and current controller techniques

l) Detailed hardware and firmware development using STM32 and C2000 series microcontroller-based digital control

[3] **A Review and Tutorial Paper:** S. Kapat and P. T. Krein, "A Tutorial and Review Discussion of Modulation, Control and Tuning of High-Performance DC-DC Converters based on Small-Signal and Large-Signal Approaches" **(download)**, *IEEE Open Journal of Power Electronics,* vol. 1, pp. 339 - 371, Aug. 2020

This is a unique paper and one of the most downloaded papers in the *IEEE Open Journal of Power Electronics*. This paper (i) presents an overview of conventional modulation and control methods, (ii) identifies small-signal performance limits, (iii) discusses large-signal-based control approaches, and (iv) compares strategies for controller tuning.

DEVELOPMENT OF INDUSTRY ADVANCED TRAINING PROGRAM

Industry name	Training course title	Hours	Time
Qualcomm	Modeling Techniques and Validation Methodologies in Closed-Loop Switched Mode Power Converter Products	**40**	June/July 2022
STMicroelectronics	Modeling, Analysis and Design of Fixed-Frequency Control Methods in DC-DC Converters and MATLAB based Design Automation	**40**	January – June, 2022
HCL Technologies	Digital Control Techniques in Switched Mode Power Converters	**48**	April – July 2021
Qualcomm	Control Techniques in Switched Mode Power Converters	**30**	May – July 2021
STMicroelectronics	Power Management Circuits, Modelling, Control, Analysis, and Design	**40**	March 2020
NXP Semiconductor	Modeling and Control of Switched Mode Power Converters	**20**	2018-2019

INDUSTRY COLLABORATION EXPERIENCE

- **Collaborating industries –** STMicroelectronics, Qualcomm, Texas Instruments, MathWorks, NXP, HCL Technology, GE Global Research
- **Industry-academic collaboration models**
  a) Joint research and development along with publications in top-tier conferences, such as APEC
  b) Consultancy project to solve industry-specific problems
  c) Advanced training programs for top-tier industries for skillset development of their employees
  d) Joint student projects for Master's degree and undergraduate students

RESEARCH INTERESTS and SUMMARY of CONTRIBUTIONS

1. Modeling, analysis, design, and control techniques in DC-DC converters
2. Digital control architectures and sampling techniques in power management converters
   - Proposed event-based constant on/off-time digital current control techniques in buck, boost, multilevel converters, series capacitor buck converter (to be presented in ECCE 2024)
   - Proposed event-based hysteretic digital control techniques (paper1, paper2, paper3)
   - Proposed event-triggered chattering-free sliding mode control
   - Proposed event-based sampling in fixed frequency digital control techniques in dc-dc converters
   - Multimode digital control techniques for wide operating range (paper1, paper2, paper3, paper4)
3. Modelling, analysis, and design of digitally controlled power management converters
   - Modeling, analysis, and design of multiphase converters (paper1, paper2, paper3, paper4, paper5)
   - Modelling of LLC resonant converters (paper1, paper2) and design method for output impedance shaping
   - Modeling and design of digitally controlled DC-DC converters (paper1, paper2, paper3, paper4, paper5, paper6, paper7, paper8)
   - Digitally controlled SIMO converters (paper1, paper2, paper3)
   - Nonlinear analysis of digitally controlled DC-DC converters (paper1, paper2, paper3, paper4)
4. High-performance control and large-signal-based design for ultra-fast transient performance
   - Large-signal based controller design in DC-DC converters for ultra-fast transient performance (paper1, paper2, paper3, paper4, paper5, paper6, paper7, paper8, paper9, paper10, paper11, paper12, paper13)
5. Power management converters and control techniques for dynamic voltage scaling
   - Power converter architectures for ultra-fast DVS transition (paper1, paper2, paper3, paper4)
   - Control techniques for ultra-fast voltage transitions (paper1, paper2, paper3)
6. Power management converters and control techniques for LED driving applications (paper1, paper2, paper3)
7. Power converter architectures and control techniques in 48V data centers and automotive applications (paper1, paper2, paper3, paper4, paper5, paper6, paper7, paper8)
8. GaN-based converters for emerging applications
9. Battery chargers and battery management systems
10. Power management integrated circuits (PMICs) – digital and mixed-signal VLSI for SMPCs

THEORY COURSES DEVELOPED/TAUGHT at IIT Kharagpur

- Introduced a course, **Embedded Control of Switching Power Converters,** in 2014
- Team lead to introduce two hands-on courses entitled i) "**Electronic System Development and Prototyping**" for graduate and senior undergraduate students and ii) "**Electronic System Design**" for undergraduate students.
- Master' degree courses taught: **Embedded Control of Switching Power Converters, Electric Vehicle, Automotive Electronics, Digital Control, Nonlinear Control, Control Theory, Estimation of Signals and Systems, Modelling and Identification, Programmable and Embedded Systems**

- Undergraduate courses taught: **Electrical Technology, Control System Engineering, Embedded Systems**

SUMMARY RESEARCH PUBLICATIONS/PATENTS

	Single-authored publications	Multi-authored publications	Total
Journal publications	**5**	**35**	**40**
Conference papers	**14**	**76+6**	**96**
Patents filed/granted		**3** filed + **10** granted	**13**

COMPLETE LIST OF PUBLICATIONS/PATENTS

Journal publications:

[1] P. Majumder, S. Kapat, D. Kastha, and A. Maulik, "Stability Analysis and Controller Design for Parallel Operated Digitally Current Mode Controlled Series Capacitor Buck Converters with Fast Transient," accepted in *IEEE Journal of Emerging and Selected Topics in Power Electronics*, 2025.

[2] P. Majumder, T. Golla, S. Kapat, and D. Kastha, "A Multivariable Approach of Small-Signal and Large-Signal Design Techniques in a Current Mode Series Capacitor Buck Converter for Fast Recovery," in *IEEE Open Journal of Power Electronics*, vol. 6, pp. 983-1001, 2025, doi: 10.1109/OJPEL.2025.3572696.

[3] P. Majumder, D. Chatterjee, S. Kapat, and D. Kastha, "Modeling, Digital Control, and Design Techniques in a Novel Cascaded 48-to-PoL Architecture for Fast Transient Response and Enhanced Stability," in *IEEE Transactions on Industry Applications*, doi: 10.1109/TIA.2025.3588807.

[4] D. Chatterjee, S. Kapat, I. N. Kar, and M. Bhowmik, "Discrete-Time State Feedback Design Approach in a Digitally Current Mode Controlled Boost Converter for Improving Transient Performance and Stability," in *IEEE Transactions on Power Electronics*, doi: 10.1109/TPEL.2025.3578346.

[5] R. Garnayak, S. Kapat, and C. Chakraborty, ``Constant On/Off-Time Digital Current Control and Design Methods in 3-Level Flying Capacitor Boost Converters for Fast Transient and Voltage Balancing", **(download),** *IEEE Trans. Power Electron.,* vol. 39, no. 3, pp. 2980-2990, March 2024.

[6] R. Garnayak, P. Majumder, S. Kapat, and C. Chakraborty, ``A Hybrid Design Framework for Fast Transient and Voltage Balancing in a Three-level Flying Capacitor Boost Converter with Digital Current Mode Control", accepted for publication, **(download),** *IEEE Trans. Power Electron.,* vol. 38, no. 11, pp. 13674-13685, November 2023.

[7] H. Sahoo, S. Kapat, and B. Singh, ``Small-Signal Modelling and Analysis of Converter Interactivity in 48 V DC Grid", **(download),** *IEEE Trans. Industry Applications,* vol. 59, no. 5, pp. 5622-5632, September-October, 2023.

[8] S. Khatua, D. Kastha and S. Kapat, "A Dual Active Bridge Derived Hybrid Switched Capacitor Converter Based Two-Stage 48 V VRM," **(download),** *IEEE Trans. Power Electron.*, vol. 36, no. 7, pp. 7986-7999, July 2021.

[9] A. Acharya, V. I. Kumar and S. Kapat, "Dynamic Bus Voltage Reconfiguration in a Two-Stage Multiphase Converter for Fast Transient," **(download),** *IEEE Journal of Emerging and Selected Topics in Power Electronics*, vol. 9, no. 1, pp. 48-57, Feb. 2021

[10] R. Roy and S. Kapat, "Input Filter-Based Ripple Injection for Mitigating Limit Cycling in Buck Converters Driving CPL," **(download),** *IEEE Journal of Emerging and Selected Topics in Power Electronics*, vol. 9, no. 2, pp. 1315-1327, April 2021

[11] R. Roy and S. Kapat, "Discrete-Time Framework for Analysis and Design of Digitally Current-Mode-Controlled Intermediate Bus Architectures for Fast Transient and Stability," **(download),** *IEEE Journal of Emerging and Selected Topics in Power Electronics*, vol. 8, no. 4, pp. 3237-3249, Dec. 2020.

[12] S. Khatua, D. Kastha and S. Kapat, "A New Single-Stage 48-V-Input VRM Topology Using an Isolated Stacked Half-Bridge Converter," **(download),** *IEEE Trans. Power Electron.,* vol. 35, no. 11, pp. 11976-11987, Nov. 2020

[13] S. Kapat and P. T. Krein, "A Tutorial and Review Discussion of Modulation, Control and Tuning of High-Performance DC-DC Converters based on Small-Signal and Large-Signal Approaches" **(download)**, *IEEE Open Journal of Power Electronics,* vol. 1, pp. 339 - 371, Aug. 2020.

[14] R. Roy, I. Kumar, and S. Kapat, "Ripple Voltage Injection to Mitigate Limit Cycle in Digitally Controlled Intermediate Bus Architectures", **(download),** *IEEE Trans. Power Electron.,* vol. 35, No. 3, pp. 3127 - 3138, Mar. 2020.

[15] K. Hariharan, S. Kapat, and S. Mukhopadhyay, "Constant Off-Time Digital Current-Mode Controlled Boost Converters with Enhanced Stability Boundary" **(download)**, *IEEE Trans. Power Electron.,* vol. 34, No. 10, pp. 10270 - 10281, Oct. 2019.

[16] S. Kapat, "Sampling-Induced Border Collision Bifurcation in a Voltage-Mode DPWM Synchronous Buck Converter" **(download)**, *IEEE Trans. Cir. Syst. II,* vol. 66, No. 6, pp. 1048 - 1052, June 2019.

[17] K. Hariharan, S. Kapat, and S. Mukhopadhyay " Constant On/Off-Time Hybrid Modulation in Digital Current-Mode Control using Event-Based Sampling," **(download)**, *IEEE Trans. Power Electron.,* vol. 34, No. 4, pp. 3789 - 3803, April 2019.

[18] K. Hariharan and S. Kapat, "Near Optimal Controller Tuning in a Current-Mode DPWM Boost Converter in CCM and Application to a Dimmable LED Array Driving," **(download)**, *IEEE Journal of Emerging and Selected Topics in Power Electronics,* vol. 7, No. 2, pp. 1031 - 1043, June 2019.

[19] B. C. Mandi, S. Kapat, and A. Patra, "Unified Digital Modulation Techniques for DC-DC Converters over a Wide Operating Range: Implementation, Modeling, and Design Guidelines " **(download)**, *IEEE Trans. Cir. Syst. I,* vol. 65, No. 4, pp. 1442 - 1453, Apr. 2018.

[20] A. K. Singha and S. Kapat, " Analyzing the Effects due to Discontinuous Output-Voltage Ripple in a Digitally Current-Mode Controlled Boost Converter, " **(download)**, *IET Power Electron.,* vol. 11, No. 6, pp. 1055 - 1065, Jun. 2018.

[21] A. K. Singha, S. Banerjee, and S. Kapat, " Enhanced Stability Caused by One-Cycle Delay in a Digital Current-Mode Controlled Buck Converter, " **(download)**, *IEEE Trans. Cir. Syst. II,* vol. 65, No. 12, pp. 1979 - 1983, Dec. 2018.

[22] S. Kapat and I. Kumar, "Single-Inductor Multi-Output-Level Buck Converter for Reducing Voltage-Transition Time and Energy Overheads in Low Power DVS-Enabled Systems " **(download)**, *IEEE Trans. Power Electron.,* vol. 33, No. 3, pp. 2254 - 2266, Mar. 2018.

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[2] A. Keshri, D. Mandal, and S. Kapat, "TWO-STAGE ZERO CURRENT DETECTION FOR SINGLE INDUCTOR MULTI-OUTPUT (SIMO) DIRECT CURRENT (DC)–DC CONVERTER", filed Indian Patent with application #**202431035266** in 2024.

[3] R. Roy and S. Kapat, "Control System for Interleaved Multiphase Buck Converter to Ensure Equal Current Sharing Among its Phases", **granted** Indian patent in 2024.

[4] R. Roy and S. Kapat, "An improved method to mitigate the sub-harmonic instability in the closed-loop intermediate bus converter of a non-isolated intermediate bus architecture ", filed Indian Patent, 2019.

[5] A. Acharya, I. Kumar, and S. Kapat, " Dynamic Bus Voltage Reconfiguration in a Two-Stage Multi-Phase Buck Converter for Transients Mitigation ", **granted** Indian patent in 2024.

[6] K. Hariharan and S. Kapat, " Multi-mode Digital control of Constant On-Time modulation in a DC-DC converter with Superior Performance and Programmable Switching Frequency ", **granted** Indian patent in 2024.

[7] R. Roy and S. Kapat, " A novel control mechanism for mitigating the limit cycle oscillations in a non-isolated intermediate bus converter driving a constant power load ", **granted** Indian patent in 2024.

[8] I. Kumar and S. Kapat, " A Dynamic Voltage Scaling Enabled Per Cluster/Core Ultra-Fast Power Supply System For Multi-Core Processors ", **granted** Indian patent in 2025.

[9] R. Roy, I. Kumar, and S. Kapat, " A Novel Control Mechanism for Mitigating the Limit Cycle Oscillations in Intermediate Bus Architecture - A Fixed Frequency DPWM Technique for the PoL Converter Using the Intermediate Voltage Ripple ", **granted** Indian patent in 2023.

[10] S. Kapat, " Apparatus Equipped for Reconfiguring DC-DC Converter Augmentation for Ultra-fast Transient Recovery ", **granted** Indian patent in 2023.

[11] S. Kapat and K. Hariharan, "Methods of Formulating and Tuning a Current Mode Controlled DC-DC Boost Converter for High Performance Using Normalized Output Current ", **granted** Indian patent in 2023.

[12] S. Kapat, A. Patra, and S. Banerjee, "Switching Power Converter Adapted for Improved Output Impedance and Load Regulation through Inductor Current Filtering", **granted** Indian patent in 2022.

[13] S. Kapat and A. Patra, "Method for Improvement of Light Load Efficiency of a DC-DC Converter by Skipping Pulses through a Voltage Mode Control Loop", **granted** Indian patent in 2022.