



Power and Energy Conference at Illinois

**15TH ANNUAL CONFERENCE:
GENERATING POWERFUL
NEW IDEAS**

April 19, 2024

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Engineering **B**uilding

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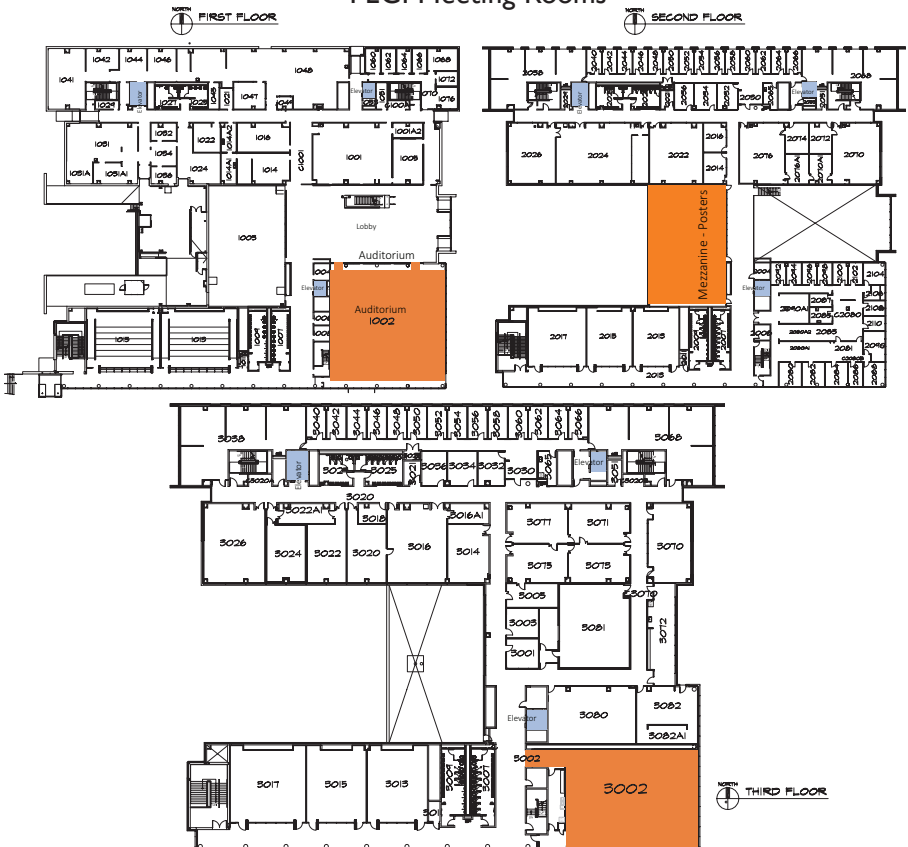


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Welcome to the IEEE 2024 Power and Energy Conference
at Illinois, “Generating Powerful New Ideas.”

PECE 2024 is the perfect place to investigate future power and energy technologies presented by leading industry and academic experts in the power and energy field.

PECE Meeting Rooms



FRIDAY, APRIL 19, 2024

7:30 AM	Breakfast and Registration	ECEB 3002
8:45 AM	Welcome: Prof. Emeritus Phil Krein & PEGI Co-Chair Raya Mahony	3002
8:50 AM	Coordinated Trajectory Control of Sources & Loads in DC Microgrids with GAN-based Flexible DC Energy Router Nihanth Adina (The Ohio State University)	3002
9:10 AM	Break - Networking	
9:15 AM	Keynote I: Overview of Electrified Aircraft Propulsion at NASA: Jesse R. Quinlan (NASA)	3002
10:15 AM	Young researcher I: Grid-Forming Control Foundations for Converter-Dominated Power Systems Prof. Dominic Groß (UW-Madison)	3002
10:45 AM	Break - Networking	
10:50 AM	Leveraging Permian Basin Assets for the Emerging Clean Hydrogen Economy: Grace Childers (UT-Austin)	3002
11:10 AM	Signed Distance Function-based Analytical Modeling of Electric Machine Geometry: Andrés Beltrán-Pulido (Purdue University)	3002
11:30 AM	Young researcher 2: Scaling Trends for Passive Components in High-Density Power Converter Designs Prof. Nathan Brooks (Rose Hulman Institute of Technology)	3002
12:00 PM	Lunch	3002
1:00 PM	Tech Talk: Women in Engineering Dr. Yingying Kuai (Engineering Team Lead - Electrification & Energy Solutions Division: Caterpillar)	3002
1:30 PM	Panel: Lab to Life - Moderated by Josh Feldman Dr. Matt Magill (Switched Source LLC), Dr. Tim O'Connell (PC Krause) & Prof. Kiruba Haran (UIUC)	3002
2:30 PM	Posters: Second Floor Mezzanine	
3:15 PM	Young researcher 3: Aviation Electrification and High-Speed, High-Power-Density Electric Machines for Aviation Applications Dr. Xuan (Melody) Yi (GE)	3002
3:45 PM	An 11-kW Bidirectional On-board Charger with Highly Integrated SiC-Cascode Technology: Juan Carlos Rodriguez (Analog Devices Inc)	3002
4:05 PM	A Modular Multi-phase High-Power Resistive Load Bank with Zero-Current Switching Functionality: Benjamin Liao (UC Berkeley)	3002
4:25 PM	Break - Networking	
4:30 PM	Young researcher 4: The value of Interdisciplinary Endeavors for At-Scale Transformation of Energy and Power Systems Serena Patel (Energy Research Associate at The Brattle Group)	1002
5:00 PM	Young researcher 5: Advancements in Superconducting Electric Propulsion: Updates on CHEETA and CRUISE Motors Dr. Thanatheepan Balachandran (Hinetics LLC)	1002
5:30 PM	Keynote II: Power Electronic Converters for Electric Aircraft Propulsion – Challenges and Advancements Prof. JiangBiao He (University of Kentucky)	1002
6:30 PM	Banquet and Awards & PEGI Co-Chair Parag Bajaj	3002

KEYNOTE SPEAKERS

Jesse R. Quinlan

Dr. JESSE QUINLAN serves as the Strategic Technical Advisor to the Advanced Air Vehicles Program (AAVP) Office in the NASA Aeronautics Research Mission Directorate (ARMD). He leads technical strategy for a portfolio of six advanced vehicle technologies projects, spanning subsonic, transonic, and hypersonic applications and both rotorcraft and fixed-wing configurations.



Prior to joining AAVP, Dr. Quinlan was Branch Head for the Aeronautics Systems Analysis Branch within the Systems Analysis and Concepts Directorate at NASA Langley Research Center, where he was responsible for supervision, workforce development, strategy, and technical execution for aeronautics systems analysis supporting numerous projects and programs within ARMD.

Dr. Quinlan has published more than 30 technical papers, co-authored a book chapter, holds two patents for advanced aircraft concepts, and has co-developed publicly released software. He is a Senior Member of the American Institute of Aeronautics and Astronautics.

Outside of NASA, Dr. Quinlan serves as an adjunct professor at the University of Virginia, where he teaches the fourth year, undergraduate aircraft design capstone course series. Dr. Quinlan earned an MS degree from the Georgia Institute of Technology and a PhD from the University of Virginia.

JiangBiao He

JIANGBIAO HE is an Associate Professor in the Department of Electrical and Computer Engineering at the University of Kentucky (UK). Previously, he worked in various large industry R&D centers, including as a Lead Engineer at GE Global Research in Niskayuna, New York, with Rockwell Automation as a power engineer, and Eaton Corporate Research working on high-efficiency SiC power converters. He obtained his Ph.D. in Electrical Engineering from Marquette University, Wisconsin, with an emphasis on electric power.



Dr. He's research interests focus on high-performance power electronics and motor-drive systems for broad emerging applications, including transportation electrification, renewable energy, and others. At GE, he led the execution of the first megawatt-scale medium-voltage high-speed propulsion drive for hybrid-electric aircraft in the global aviation area, which won the GE Whitney Technical Excellence Award (highest recognition for breakthrough technology innovation at GE-GRC). He is the author/coauthor of around 150 peer-reviewed technical articles, one textbook, and 10 U.S. patents.

Since 2016, Dr. He has been a Senior Member of IEEE and has served as an Associate Editor for multiple journals. He received the 2021 Outstanding Teacher Award from the UK ECE Department and 2023 Faculty Excellence in Research Award from UK College of Engineering. He was also recognized on Stanford University and Elsevier's list of World's Top 2% Scientists in 2022 and 2023.

YOUNG RESEARCHERS

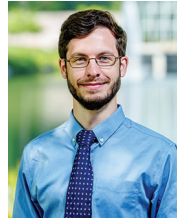
DOMINIC GROß

DOMINIC GROß is an Assistant Professor in the Department of Electrical and Computer Engineering at University of Wisconsin-Madison, Madison. He received his Ph.D. in Electrical Engineering from the University of Kassel, Germany, in 2014. Prior to joining UW-Madison, he was a postdoctoral researcher at the Automatic Control Laboratory of ETH Zürich. He received an NSF CAREER award in 2022 and is the lead for control research in the DOE-sponsored UNIFI consortium. His research focuses on grid-forming control of power electronics-interfaced renewable generation, such as wind and solar power, that is envisioned to be the cornerstone of tomorrow's resilient zero-carbon power system. Starting from a rigorous foundation in distributed control and optimization, his work aims to bridge the gap between power system stability analysis and advanced control of converter-interfaced generation, storage, and transmission.



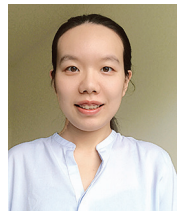
NATHAN BROOKS

NATHAN BROOKS is an Assistant Professor of Electrical and Computer Engineering at his Alma Mater, the Rose-Hulman Institute of Technology, Terre Haute, IN. He received the B.S. degree in Electrical Engineering from the Rose-Hulman Institute of Technology in 2016, the M.S. degree in Electrical Engineering from the University of Illinois at Urbana-Champaign, IL, in 2018, and the Ph.D. degree in Electrical Engineering and Computer Sciences at the University of California at Berkeley, CA, in 2023. His teaching interests include introductory circuit analysis, introductory control systems, signal processing, and power electronics. His research interests include dynamic modeling of switched circuits, high-performance circuit layout, passive component characterization, and high-density design of single-phase and multilevel power converters.



MELODY YI

XUAN (MELODY) YI (Ph.D. UIUC 2020) is a lead engineer of electric machines at GE Aerospace Research and has more than five years of experience in high-power-density, high-speed electric machine design, development, prototyping and testing for aviation electrification applications. She is one of the key contributors of UIUC IMW high-speed high-frequency air-core PM machine development funded by NASA (2014-2020). She continues high-power-density machine development efforts in GE Research's hybrid electric propulsion and unmanned vehicle power generation programs (including RISE, EPFD, and AFWERX) covering 100kW to IMW electromagnetics design and engine system integration analysis. Melody has authored 20 peer-reviewed publications and has six patents (issued or pending).



YOUNG RESEARCHERS

SERENA PATEL

SERENA PATEL (she/hers) recently graduated from the Technology and Policy Program from the Massachusetts Institute of Technology and now works at the Brattle Group as an Energy Research Associate. As a graduate researcher at MIT, her work focused on evaluating the techno-economics of repurposing stranded coal power plants into long-duration energy storage to inform global just-transition strategies. She holds a B.S. in Energy Engineering from the University of California, Berkeley and her previous work explored applied community-scale electricity solutions in the context of California and East Africa.



THANATHEEPAN BALACHANDRAN

THANATHEEPAN BALACHANDRAN is the Director of Engineering at Hinetics, an advanced technology company specializing in high power density electric motors. He earned his Ph.D. from the University of Illinois at Urbana-Champaign in 2022, focusing on the design, with an emphasis on multi-physics modeling, of electric machines for next-generation green energy applications. In his role at Hinetics, he spearheads multiple electric motor projects in collaboration with NASA and ARPA-E. Theepan serves as the principal investigator for the design and development of a 2.5 MW NASA-CHEETA fully superconducting aircraft motor and an ARPA-E 10-MW partially superconducting motor. He also leads the Phase II NASA SBIR project, demonstrating propulsor integration of a 300 kW, high-specific power direct-drive electric motor. As the lead electromagnetic designer of these machines, Theepan oversees prototyping efforts, task management, and performance testing, ensuring the successful realization of innovative electric propulsion solutions



TECH TALK: WOMEN IN ENGINEERING

YINGYING KUAI

YINGYING KUAI is an engineering manager with the Electrification and Energy Solutions Division of Caterpillar Inc. She and her team are responsible for developing purchased-finished power electronics components for Caterpillar's electric machines. During her ten-year tenure with Caterpillar, she has proposed and led numerous critical power-conversion programs for Caterpillar microgrid solutions as well as e-drivetrain development. She also promotes diversity for a more inclusive and productive workplace. Yingying has served as the Global Chair for Caterpillar's Chinese Resource Group, Vice Chair of IEEE PELS Young Professionals organization, and on advisory boards for a Children's museum and symphony orchestra. She holds a Ph.D. degree from the University of Illinois at Urbana-Champaign in Electrical Engineering.



PANEL: LAB TO LIFE

Matt Magill

MATT MAGILL is Director of Controls Engineering at Switched Source, where he is involved in the development and production of distribution-level power electronics for the power grid. He received M.S. and Ph.D. degrees from the University of Illinois at Urbana-Champaign (UIUC) in electrical engineering with a focus in electric machines and power electronics.



Previously, Matt was a controls engineer at Sandia National Laboratories where he was a chief engineer and autopilot lead for multiple flight vehicles. From 2020–2022 he was the Deputy Director of the Joint Hypersonics Transition Office in the Pentagon where he oversaw a university consortium and an \$80M S&T portfolio. Matt has experience in technical leadership, flight vehicle control, large multi-domain simulations, and coordination with senior leaders across government agencies, national laboratories, industry, and academia.

TIM O'CONNELL

TIM O'CONNELL is a Senior Lead Engineer at P.C. Krause & Associates and an Adjunct Research Assistant Professor of Electrical and Computer Engineering at the University of Illinois at Urbana-Champaign. He earned M.S. and Ph.D. degrees in electrical engineering from UIUC in 2005 and 2008, respectively.



Since 2019, Tim has served as Systems Modeling Engineer supporting a major airframer's effort to design, verify, build and test flight-worthy hardware for deployment on an active DoD air platform. For over fifteen years he has supported numerous aircraft electrification-based projects and developed and taught short courses and webinars in this area. Tim has co-authored over 20 technical papers and three textbooks on electric machines and co-edited a book on electrified aircraft propulsion. He is currently Senior Editor of *IEEE Transactions on Aerospace and Electronic Systems*. Tim has attended every PECE conference since its inception in 2010!

KIRUBA HARAN

PROFESSOR KIRUBA HARAN is the Grainger Endowed Director's Chair in Electric Machinery and Electromechanics in the Department of Electrical and Computer Engineering at the University of Illinois at Urbana-Champaign. Kiruba moved to Illinois from GE Research, where he developed electrical machines for applications ranging from power generation to aviation and defense. At Illinois, his work has focused on high specific power machines for electrified transportation and renewable energy. Kiruba is a fellow of the IEEE and a member of the National Academy of Engineering.



TECHNICAL PRESENTATION: PAPERS

Presentations		3002 ECEB
8:50	*Nihanth Adina, Zhining Zhang, Yifan Shi, Pengyu Fu, and Jin Wang The Ohio State University	Coordinated Trajectory Control of Sources & Loads in DC Microgrids with Gan-based Flexible DC Energy Router
10:50	Andrea Kowa, *Grace Childers, Emily Beagle, and Michael Lewis University of Texas at Austin	Leveraging Permian Basin Assets for the Emerging Clean Hydrogen Economy
11:10	*Andrés Beltrán-Pulido, Raquel Sandoval-Aguilar, Ilias Bilionis, and Dionysios Aliprantis Purdue University	Signed Distance Function-based Analytical Modeling of Electric Machine Geometry
3:45	Juan Carlos Rodriguez Industry at Analog Devices, Inc.	An 11-kW Bidirectional On-board Charger with Highly Integrated SiC-Cascode Technology
4:05	*Benjamin Liao, Logan Horowitz, Tahmid Mahbub, and Robert Pilawa-Podgurski University of California, Berkeley	A Modular Multi-Phase High-Power Resistive Load Bank with Zero-Current Switching Functionality

TECHNICAL PRESENTATION: POSTERS

Posters		Displayed from 2:30 PM through 3:15 PM: Second Floor Mezzanine
#1	*Moein Choobineh and James Stoupis Industry at ABB	An Adaptive Overcurrent Protection Technique for Microgrids
#2	Tumin Wu ¹ , *Mohammed Olama ² , and Seddik Djouadi ¹ ¹ University of Tennessee ² Oak Ridge National Laboratory	Model-free Control of Indoor Temperatures in Residential Buildings: Convergence Analysis
#3	*Eleanor Adachi, Eli Brock, and Ruth Kravis University of California, Berkeley	Understanding Price Formation in Grids Transitioning to Zero Marginal Cost Generation
#4	Shereefdeen Oladapo Sanni ¹ , Olatunji Obalowu Mohammed ² , Ayodele Isqeel Abdullateef ² , *Emmanuel Oluwatobi Badmus ³ , and Femi Ikotoni Bawonda ⁴ ¹ Federal University Oye Ekiti, Nigeria ² University of Ilorin, Nigeria ³ University of Vermont, Burlington ⁴ Kogi State Polytechnic, Nigeria	Strengthening the Nigerian Grid: Impact of SCR Thresholds on Synchronous Condenser Allocation for Inverter-based Generation
#5	*Jonathan Saelens, Lauryn Morris, Oroghene Oboreh-Snapps, Arnold Fernandes, Praneeth Uddarraju, Sophia A. Strathman, and Jonathan W. Kimball Missouri University of Science and Technology, Rolla	Instantaneous Current and Average Power-Flow Characterization of a DC-DC-DC Triple Active Bridge Converter
#6	*Farnaz Safdarian, Jordan Cook, Seung Jun Lee, and Thomas J. Overbye Texas A&M University, College Park	Calculation and Validation of Weather-Informed Renewable Generation in the US Based on ERA5 Hourly Weather Measurements
#7	*Mostafaali Ayubirad ¹ , Zeng Qiu ² , Hao Wang ² , Chris Weinkauff ² , Michiel Van Nieuwstadt ² , and Hamid R. Ossareh ¹ ¹ University of Vermont ² Industry at Ford Motor Company	Model-based Temperature-Tracking Control in Automotive Fuel Cells
#8	*Maximus Ren ¹ and Murali Baggu ² ¹ Minnetonka High School, Minnetonka, MN ² National Renewable Energy Laboratory, Golden, CO	A New High-Impedance-Fault Detection Method to Prevent Power-Line-Induced Wildfires

POSTER PRESENTATIONS

Posters		Displayed from 2:30 PM through 3:15 PM: Second Floor Mezzanine
#9	*Jaeyeong Lim and Abdollah Shafieezadeh The Ohio State University, Columbus	Regional Variability in the Environmental Impact of Power Grid Components: A Life Cycle Assessment of Pentachlorophenol-Treated Wooden Utility Poles
#10	Mukul Agarwal SaCh Energy Consultants	Free Energy to the World
#11	*Ninad Gaikwad, Shishir Lamichhane, and Anamika Dubey Washington State University, Pullman	Smart Residential Community Simulator for Developing and Benchmarking Intelligent Energy Management Systems
#12	*Omkar Nilesh Kulkarni and *Mia Mikolajczak University of Illinois at Urbana-Champaign	Introducing Calypso, Illini Solar Car's Next Generation Vehicle
#13	Ajay Yadavi, *Mohammed M. Olama, Emilio Piesciorovsky, Yonghao Gui, Narayan Bhusal, and Nils Stenvig Oak Ridge National Laboratory, TN	Inertia Estimation under High Penetration of Inverter-Based Resources
#14	*Zekarias Yeabiyo Dimtsu, Cheng-Chien K, and E. M. Molla National Taiwan University of Science and Technology	Power Quality Improvement in Sensitive Load Using Dynamic Voltage Restorer with ANN
#15	*Justin Ugwu and Paul Cuffe University College Dublin	Towards the Use of Node Splits and Confluences as a Clustering Technique in a Directed Acyclic Graph
#16	*Brent Schaaf and Ali Albaghdadi University of Illinois at Urbana-Champaign	48V DC Power Distribution System for Liquid Rocket
#17	*Dhruv Kulgood and Josh Jenks University of Illinois at Urbana-Champaign	Illini Electric Motorsports: Formula Electric Powertrain
#18	*Curtis Lam and Adi Nikumbh University of Illinois at Urbana-Champaign	Illini Electric Motorsports: Formula Electric High Voltage Battery

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Thanks to our supporters. These groups are leaders in the Power and Energy area, and many University of Illinois power group grads have joined their ranks.

Vote for the Best Paper and Best Poster Awards

Awards will be given for Best Overall Paper and Best Presentation, and for posters, the Best Presentation and Most Creative Visuals. Thanks for your comments. They are very helpful.

Give Us Your Feedback

We would love to hear your opinion about PECI 2024! A quick survey is at



and <https://forms.gle/2oQ2S3oyqCKk7iZM9>

Thanks for helping us make PECI even better.

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PECI 2024

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Thank you from the PEGI organizers

We sincerely thank you for your participation in PEGI 2024. This year's committee has worked hard to bring together an excellent program of technical and professional presentations covering topics across the power and energy disciplines, including two keynote speakers, five young researchers, a panel discussion, a tech talk, five paper presentations, and eighteen posters. We greatly appreciate your support and feedback in making PEGI a continued success.

Special thanks to:

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ECE Business Office, especially Catherine Somers, Beverly Curtis, Nina Stadler, Scott Corum and Caitlyn Naive

Thank you,

The PEGI 2024 Committee

