Paprapee Buason, Ph.D.

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Education

- **Georgia Institute of Technology** — Atlanta, GA
  Doctor of Philosophy in Electrical Engineering; GPA: 3.88/4.00 — *August 2019 - December 2023*
  - **Dissertation**: *Sample-Based Power Flow Approximations: Computational Methods, Analysis, and Applications*
  - **Field of Specialization**: Power and Energy Systems - Control and Optimization Techniques to Improve Reliability and Resiliency of Power Systems
  - **Minor**: Industrial and Systems Engineering (ISyE)
- **University of Illinois at Urbana-Champaign** — Urbana, IL
  Master of Science in Electrical Engineering; GPA: 3.89/4.00 — *August 2016 - May 2019*
  - **Thesis**: *Cyber-Physical Systems of Microgrids and Control Strategies for Enhancing Electrical Grid Resilience*
  - **Field of Specialization**: Power and Energy Systems - Dynamic and Stability of Power Systems
- **University of Illinois at Urbana-Champaign** — Urbana, IL
  Bachelor of Science in Electrical Engineering; GPA: 3.86/4.00 — *August 2012 - May 2016*
  - **Thesis**: *Computational Electromagnetic Study of Reduction of Skin-Effect Losses by Using Laminated Conductors*
  - **Field of Specialization**: Power Electronics/Circuits
  - **Minors**: Mathematics and Physics

Work Experience

- **Los Alamos National Laboratory** — Los Alamos, NM
  Postdoctoral Research Associate — *January 2024 - Present*
  - **Machine Learning for Power Systems**: Utilize machine learning techniques to enable efficient solutions to optimization problems in critical infrastructure networks with a focus on reliability and resiliency
  - **Sample-Based Conservative Bias Power Flow Approximations**: Develop a conservative bias power flow approximation formulation that is tailored to the specific system and operating range, optimal with respect to an error metric, and strikes a balance between conservativeness and accuracy. Our paper was accepted and presented at IEEE IAS Industrial and Commercial Power System Asia (IEEE I&CPS Asia) in Pattaya City, Chonburi, Thailand. The organizers of the conference have selected our paper to be reviewed for possible publication in the IEEE Transactions on Industry Applications (TIA).
  - **Conservative Piecewise Power Flow Linearizations**: Develop a conservative piecewise power flow approximation that reduces the approximation error compared to traditional power flow methods while maintaining linearity in the constraints. Our paper is accepted to 2025 IEEE Kiel PowerTech.
- **PB Supercar** — Bangkok, Thailand
  Co-founder — *July 2015 - December 2024*
  - **Automobile expert and reviewer**: Create and present the automobile contents for the YouTube channel with over **600,000** subscribers and **124 million** views on YouTube.
- **Georgia Institute of Technology** — Atlanta, GA
  Graduate Research Assistant — *August 2019 - December 2023*

- **Power Flow Problems**: Developed the algorithm to compute axis rotations in Fast Decoupled Power Flow (FDPF) method resulting in up to 54% reductions in the number of iterations.
- **Power System Optimization and Security**: Identified critical locations for distribution grid monitoring and control using advanced optimization techniques based on convex relaxations and power flow approximations to avoid the violation and failure in the power system.
- **State Estimation and Stochastic Optimization**: Developed the algorithm to recover the solution from convex relaxation of stochastic non-convex optimization problems using state estimation and advanced optimization techniques.

- **Lawrence Livermore National Laboratory** — Livermore, CA
  Computing Graduate Student Intern — *May 2023 - August 2023*
  - **Linear Approximations and Second-Order Sensitivity Analysis**: Derived the second-order sensitivity matrix for the power flow equations to enhance computational efficiency in comparison to the previously developed conservative linear approximation. This analysis also facilitated an investigation into the convexity and concavity properties of the voltages. Our paper has been accepted to IEEE Transactions on Power Systems.
  - **Capacity Expansion Planning**: Formulated and solved a capacity expansion planning problem in MATLAB and Julia employing the iterative approach alongside a sample-based conservative linear approximation technique to enhance the quality of the solution.

- **Los Alamos National Laboratory** — Los Alamos, NM
  Graduate Research Assistant — *May 2022 - August 2022*
  - **Optimal Sensor Placement**: Developed optimization techniques to solve for optimal sensor placement that captures all possible voltage violations in distribution grids, resulting in an increase in computational tractability and a significant reduction in computation time compared to existing methods. Our paper has been published in EPSR.

- **Los Alamos National Laboratory** — Los Alamos, NM
  Graduate Research Assistant — *June 2021 - August 2021*
  - **Linear Approximations of the Power Flow Equations**: Developed conservative linear approximations to the power flow physics in power networks using high-level optimization techniques, which resulted in approximately 20% improvement in accuracy over traditional linear approximations and enabled tractable algorithms that avoid constraint violations. Our paper was presented at PSCC and has been published in EPSR.

- **Georgia Institute of Technology** — Atlanta, GA
  Graduate Teaching Assistant — *August 2019 - May 2020*
  - **Electrical Energy Systems (ECE 3072) and Circuit Analysis (ECE 2040)**: Provided students weekly tutorial sessions, graded students' weekly homework, and discussed grading scheme with the professors.

- **Information Trust Institute (ITI)** — Urbana, IL
  Graduate Research Assistant — *July 2017 - May 2019*
  - **Sensitivity Analysis**: Quantified the impact of cyber attacks on measurement to transient stability of microgrids and analyzed the worse-case bounds on dynamic states given attacks, resulting in computational efficiency of 0.0286 second as opposed to 2200 seconds from Monte Carlo simulation for a 2-second interval of estimation.
  - **Cybersecurity**: Collaborated with 5 researchers to design the multi-microgrid system for Cybersecurity for Energy Delivery Systems (CEDS) projects in MATLAB Simulink with the funding from Department of Energy (DOE) under subcontract to ABB Inc.
  - **Real-Time Simulation**: Performed the real-time simulation of microgrids under the attack circumstances in Opal-RT to study transient and steady-state analyses.
  - **Electrical Grid Resiliency**: Designed control strategies and detection algorithm to mitigate effects of cyber attacks in microgrids, resulting in more resilient and reliable microgrid system.

- **HVDC**: Implemented and tested high-voltage direct current(HVDC) electric power transmission from the IEEE 9-bus system in PowerWorld.

- **Optivolt Labs** Chicago, IL
  Power Engineering Intern *July - August 2018*
  - **Solar Battery Charger Circuit Developer**: Develop the prototype circuit to charge a 4.35V lithium ion battery from solar cells, which resulted in 10% - 20% increase in the flight time of drones.
  - **Power Optimization**: Applied and designed the maximum power transfer algorithm from solar cells to a 12V lithium polymer battery in order to maximize the power generation to the battery.
  - **Circuit Testing and Data Analysis**: Created the solar battery charger circuit and performed testing under various circumstances and analyzed data to improve the efficiency of the circuit.

- **Baancomnuan Tutor School** Bangkok, Thailand
  Tutor *May - August 2015, May - June 2017, May - August 2019*
  - **Physics and Calculus for high school and college students**: Tutoring over 30 students from diverse backgrounds in physics and mathematics.

- **Jigsaw English Tutor School** Bangkok, Thailand
  Tutor *May - June 2017*
  - **SAT Math for high school students**: Private and online tutoring in mathematics for SAT test.

- **University of Illinois at Urbana-Champaign** Urbana-Champaign, IL
  Grader *Fall 2014 - Spring 2016*
  - **Electronic Circuits (ECE 342) and Analog Signal Processing (ECE 210)**: Graded students' weekly homework and discussed grading scheme with teaching assistants.

Publications

- **Journal Papers**
  - **P. Buason**, S. Misra, and D.K. Molzahn, "Sample-Based Conservative Bias Linear Power Flow Approximations: Application on Unit Commitment," *submitted, arXiv: 2404.09876.*
  - **P. Buason**, S. Misra, J.P. Watson, and D.K. Molzahn, "Adaptive Power Flow Approximations with Second-Order Sensitivity Insights," in *IEEE Transactions on Power Systems*, doi: 10.1109/TPWRS.2024.3499899.
  - **P. Buason**, S. Misra, and D.K. Molzahn, "A Data-Driven Sensor Placement Approach for Detecting Voltage Violations in Distribution Systems," *Electric Power Systems Research*, vol. 232, no. 110387, July 2024.
  - **P. Buason**, S. Misra, and D.K. Molzahn, "A Sample-Based Approach for Computing Conservative Linear Power Flow Approximations," *Electric Power Systems Research*, vol. 212, no. 108579, 2022, presented at *the 22nd Power Systems Computation Conference (PSCC 2022).*

- **Conference Proceedings**
  - **P. Buason**, S. Misra, and D.K. Molzahn, "Sample-Based Piecewise Linear Power Flow Approximations Using Second-Order Sensitivities," to appear in *2025 IEEE Kiel PowerTech*, June 29-July 3, 2025.
  - S. Talkington, R. Gupta, R. Asiamah, **P. Buason**, and D.K. Molzahn, "Strategic Electric Distribution Network Sensing via Spectral Bandits," *61st IEEE Control and Decision Conference (CDC)*, December 16-19, 2024.

- **P. Buason**, S. Misra, and D.K. Molzahn, "Sample-Based Conservative Bias Linear Power Flow Approximations," *IEEE IAS Industrial and Commercial Power System Asia (IEEE I&CPS Asia)*, July 9-12, 2024.
- R. Gupta, **P. Buason**, and D.K. Molzahn, "Fairness-aware Photovoltaic Generation Limits for Voltage Regulation in Power Distribution Networks using Conservative Linear Approximations," *8th Texas Power and Energy Conference (TPEC)*, February 12-13, 2024.
- **P. Buason** and D.K. Molzahn, "Analysis of Fast Decoupled Power Flow via Multiple Axis Rotations," to appear in *The 52nd North American Power Symposium (NAPS)*, April 11-13, 2021.
- **P. Buason**, H. Choi, A. Valdes, and H. J. Liu, "Cyber-Physical Systems of Microgrids for Electrical Grid Resiliency," *IEEE International Conference on Industrial Cyber Physical Systems (ICPS)*, May 6-9, 2019.
- H. J. Liu, H. Choi, **P. Buason**, and A. Valdes, "Probabilistic Bounds on the Impact of Potential Data Integrity Attack in Microgrids," *52nd Hawaii International Conference on System Sciences (HICSS)*, January 8-11, 2019.

- **Ph.D. Dissertation**
  - **P. Buason**, "Sample-Based Power Flow Approximations: Computational Methods, Analysis, and Applications," *Ph.D. Dissertation, Georgia Institute of Technology School of Electrical and Computer Engineering*, December 2023.

- **Technical Report**
  - L. Roald, D.K. Molzahn, M.K. Hedman, K. Girigoudar, **P. Buason**, and M. He, "Who Are Controlling the DERs? Increasing DER Hosting Capacity Through Targeted Modeling, Sensing, and Control," *Power Systems Engineering Research Center (PSERC)*, May 2022.

- **Master's Thesis**
  - **P. Buason**, "Cyber-Physical Systems of Microgrids and Control Strategies for Enhancing Electrical Grid Resilience," *Master's Thesis, University of Illinois at Urbana-Champaign Department of Electrical and Computer Engineering*, May 2019.

- **Senior Thesis**
  - **P. Buason**, "Computational Electromagnetic Study of Reduction of Skin-Effect Losses by Using Laminated Conductors," *Senior Thesis, University of Illinois at Urbana-Champaign Department of Electrical and Computer Engineering*, May 2016.

Presentations/Talks

- **P. Buason**, S. Misra, and D.K. Molzahn, "Beyond Traditional Linearizations: Enhancing Power Flow Approximations with Second-Order Sensitivities," Speaker at *2025 International Conference on Continuous Optimization*, The University of Southern California, Los Angeles, CA, July 24, 2025.
- **P. Buason**, S. Misra, and D.K. Molzahn, "Beyond Traditional Linearizations: Enhancing Power Flow Approximations with Second-Order Sensitivities," *Postdoc Research Seminar Series*, Los Alamos National Laboratory, Los Alamos, NM, July 17, 2025.

- **P. Buason**, S. Misra, and D.K. Molzahn, "Adaptive Power Flow Approximations with Second-Order Sensitivity Insights," *2025 IEEE Kiel PowerTech*, Kiel, Germany, June 29-July 3, 2025.
- **P. Buason**, S. Misra, and D.K. Molzahn, "Sample-Based Piecewise Linear Power Flow Approximations Using Second-Order Sensitivities," Poster Presentation at *NM Postdoc Research Symposium*, Albuquerque, NM, March 28, 2025.
- **P. Buason**, S. Misra, and D.K. Molzahn, "Sample-Based Piecewise Linear Power Flow Approximations Using Second-Order Sensitivities," Poster Presentation at *Conference on Data Analysis (CoDA 2025)*, Santa Fe, NM, February 25, 2025.
- **P. Buason**, S. Misra, and D.K. Molzahn, "Adaptive Power Flow Linearizations: Sample-Based Conservative Approximations and Second-Order Sensitivity Insights," *CNLS Postdoc Seminar*, Los Alamos National Laboratory, Los Alamos, NM, November 14, 2024.
- **P. Buason**, S. Misra, and D.K. Molzahn, "Adaptive Power Flow Linearizations: Sample-Based Conservative Approximations and Second-Order Sensitivity Insights," Invited Speaker at *2024 2nd International Conference on Power and Renewable Energy Engineering (PREE)*, Tohoku University, Sendai, Japan, October 25-28, 2024.
- **P. Buason**, S. Misra, and D.K. Molzahn, "A Data-Driven Method to Identify Critical Location in Distribution Grids," *Los Alamos National Laboratory Student Symposium*, Los Alamos, NM, August 1, 2022.
- **P. Buason**, D.K. Molzahn, L. Roald, M.K. Hedman, K. Girigoudar , and M. He, "Who Are Controlling the DERs? Increasing DER Hosting Capacity Through Targeted Modeling, Sensing, and Control," Poster Presentation at *Power Systems Engineering Research Center (PSERC) IAB Meeting*, Champaign, IL, May 2022.
- K. Girigoudar, **P. Buason**, M. He, D.K. Molzahn, L. Roald, and M.K. Hedman, "Who Are Controlling the DERs? Increasing DER Hosting Capacity Through Targeted Modeling, Sensing, and Control," Student Poster Presentation at *Power Systems Engineering Research Center (PSERC)*, December 2021.
- D.K. Molzahn and **P. Buason**, "A Bilevel Optimization Approach to Sensor Placement in Electric Distribution Systems," *INFORMS Annual Meeting 2021*, October 26, 2021.
- **P. Buason** and D.K. Molzahn, "Locating Sensors to Identify Violations of Critical Limits in Distribution Systems," *IEEE Power and Energy Society General Meeting*, July 28, 2021.
- D. Parachuri, E. White, **P. Buason**, and D.K Molzahn, "Utilization of Machine Learning to Optimize Axis Rotations in Fast Decoupled Power Flow," *Georgia Tech ORS Research Technical Poster Presentation*, April 12, 2021.
- **P. Buason** and D.K. Molzahn, "Analysis of Fast Decoupled Power Flow via Multiple Axis Rotations," Poster presentation at *Los Alamos National Laboratory Grid Science Winter School and Conference*, January 12, 2021.
- **P. Buason**, H.J. Liu, H. Choi, R. Macwan and A. Valdes, "Multi-layered Resilient Microgrid Networks," *IEEE Innovative Smart Grid Technologies (ISGT) North America*, Washington, DC, February 18, 2019.
- **P. Buason**, H.J. Liu, H. Choi, and A. Valdes, "Attack Prevention Strategy in Microgrids via Reachability Analysis," Poster presentation at *2019 Grid Engineering for Accelerated Renewable Energy Deployment (GEARED)*, New Orleans, LA, February 5-7, 2019.
- **P. Buason**, H.J. Liu, M. Backes, R. Macwan, and A. Valdes, "Attack Characterization and Mitigation Logic for Decentralized Microgrid Controls," Poster presentation at *2018 Grid Engineering for Accelerated Renewable Energy Deployment (GEARED)*, San Antonio, TX, January 23-24, 2018.
- **P. Buason** and J.E. Schutt-Ainé, "Computational Electromagnetic Study of Reduction of

Skin-Effect Losses by Using Laminated Conductors," *UIUC ECE Undergraduate Research Symposium Presentation*, Champaign, IL, April 27, 2016.

- **P. Buason**, X. Chen, and J.E. Schutt-Ainé, "Reduction of Skin Effect Losses by Laminated Conductors Modeled in Ansys Q3D Extractor," Poster presentation at *UIUC Promoting Undergraduate Research in Engineering (P.U.R.E.)*, Champaign, IL, April 30, 2015.
- **P. Buason**, X. Chen, and J.E. Schutt-Ainé, "Reduction of Skin Effect Losses: Laminated Conductors Modeled in Ansys HFSS," Poster presentation at *UIUC Promoting Undergraduate Research in Engineering (P.U.R.E.)*, Champaign, IL, December 4, 2014.

Honors/Awards

- Texas Power and Energy Conference (TPEC) travel fund *March 2024*
- Graduate student research fund, Department of Electrical and Computer Engineering, Georgia Tech *2021*
- High Honors in Electrical and Computer Engineering at UIUC *May 2016*
- Undergraduate Dean's List (GPA ranks in the top 20%) at UIUC *2012-2016*
- Ranked 1st in Power Circuits and Electromechanics (ECE 330) at UIUC *Fall 2014*
- Ranked 1st in Electronic Circuits (ECE 342) class of 181 students at UIUC *Spring 2014*
- Gold medal, Math Field Day Competition at the University of Michigan Flint *February 2012*
- Two honors for national reputation from Triam Udom Suksa School, Thailand *June 2012*
- Ministry of Science and Technology of Thailand scholarship *2011 – 2023*
- Bronze medal, the 9th Thailand Physics Olympiad at Naresuan University, Thailand *May 2010*

Programming Skills

- **Programs**: MATLAB, MATLAB Simulink, Opal-RT, PSS/E, XPress, LabVIEW, SPICE, Cadence Virtuoso, ANSYS HFSS, ANSYS Q3D Extractor, Microsoft Word, Microsoft Excel, PowerWorld, Adobe Photoshop, Adobe Premiere Pro, Adobe Lightroom
- **Languages**: Python, Julia, C, Thai(native language), English(full professional proficiency)

Professional Service

- Member of the Publicity Committee for *International Conference on Power and Renewable Energy Engineering (PREE)*
- Reviewer: *International Conference on Power and Renewable Energy Engineering (PREE)*
- Reviewer: *PowerTech Conference* (2025)
- Reviewer: *IEEE Transactions on Power Systems*
- Reviewer: *Power Systems Computation Conference (PSCC)* (2020, 2022)

Activities/Leadership Experience

- Member of *IEEE PES at Georgia Tech* (2019 - 2023)
- Mentor for *Opportunity Research Scholars Program (ORS) at Georgia Tech* (2020 - 2021)
- Member of GEARED Student Innovation Board (2017 - 2018)