

Md Tanvir Arafat Khan

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Research Interests

Energy storage dynamics and optimization, Smart power distribution network, Distributed renewable electric energy conversion, Energy management system, Power system modeling and control, Plug and play residential solar system, Solid-state transformer and microgrid modeling.

Education

Ph.D., Electrical Engineering, December 2017
North Carolina State University,
Raleigh, NC
Thesis: *Modeling and Optimization of Power Distribution System Driven by Solid-State Transformers: A Nonlinear Dynamical Approach*
Advisor: Dr. Iqbal Husain, and Dr. Aranya Chakraborty
GPA: 3.90/4.0

M.Sc., Electrical Engineering, December 2014
North Carolina State University,
Raleigh, NC
GPA: 4.0/4.0

B.S., Electrical and Electronic Engineering, February
2011 Bangladesh University of Engineering and Technology
(BUET) Dhaka, Bangladesh
GPA: 3.85/4.0

Employment

06/2013–Current Research Assistant
Advisor: Dr. Iqbal Husain and Dr. Aranya Chakraborty
NSF FREEDM Systems Center
Department of Electrical and Computer Engineering
North Carolina State University
Raleigh, NC

5/2016–8/2016 Research Engineering Intern
5/2015–8/2015 Advisor: Harumi McClure and Zhang Lee
Engineering and Product Development Group
Tabuchi Electric Company of America
Ltd
San Jose, CA

01/2013–06/2014 Teaching Assistant
Department of Electrical and Computer Engineering
North Carolina State University
Raleigh, NC

3/2011–12/2012 Quality Control Engineer
Smart Solar International Ltd
Sendai, Japan

Awards and Honors

- 3 MT Thesis Finalist, Graduate School, North Carolina State University, 2016.
- IEEE Student Travel Grant Winner, ECCE, Montreal, Canada, 2015.
- 90 seconds Perfect Pitch Winner (2014) and Runner-up (2015), NSF FREEDM Systems Center, North Carolina State University.
- 90 seconds Perfect Pitch finalist, NSF National ERC Meet, Washington DC, 2014.
- Recognition of Graduate Teaching, Graduate School, North Carolina State University, 2014.
- Mentor Appreciation Award, North Carolina Science Olympiad, 2013-2014.
- Best Undergraduate Thesis, Electrical and Electronic Engineering Department, BUET, Bangladesh, 2011.
- Honorary Deans Award, Electrical and Electronic Engineering Department, BUET, Bangladesh, 2006-2010.
- National Merit Scholarship, Barisal Education Board, Bangladesh, 2003-2009.

Relevant Courses at NC State

Power System: Power System Stability and Control (ECE 736), Power System Operation and Control (ECE 550), Advanced Feedback Control for Power System (ECE 726).

Power Electronics and Electric Energy Conversion: Power Electronics Design (ECE 534), Electric Motor Drives (Special Topic, ECE 592), Control of Electric Machines (ECE 732).

Renewable Energy Management and Smart Grid: Renewable Energy Electric System (ECE 552), Business of Electric Utility (ECE 585), Smart Electric Power Distribution System (ECE 551).

Multidisciplinary: Digital Signal Processing (ECE 513), System Control Engineering (ECE 516), Computer Networks (ECE 570), Introduction to Operations Research (OR 501).

Publications

Patent/Invention Disclosure

- [I1] **M. T. A. Khan**, G. Norris, R. Chattopadhyay, Alex Q. Huang, Tommy Cleveland, Lyra Rakusin, Henry Tsai, Elie M. Najm, Mohammad A. Rezaei, Wensgon Yu, Qingyun Huang and D. Lubkeman, "Low-Cost Residential Plug and Play Photovoltaic System," submitted as Invention Disclosure in the Office of Technology Transfer, North Carolina State University, Disclosure file: 16227, May 20, 2016.

Journal Paper

- [J1] **M. T. A. Khan**, G. Norris, R. Chattopadhyay, I. Husain and S. Bhattacharya, "Autoinspection and Permitting With a PV Utility Interface (PUI) for Residential Plug-and-Play Solar Photovoltaic Unit," in *IEEE Transactions on Industry Applications*, vol. 53, no. 2, pp. 1337-1346, March-April 2017.
- [J2] **M. T. A. Khan**, A.A. Milani, A.Chakraborty and I.Husain, "Dynamic Modeling and Feasibility Analysis of a Solid-State Transformer Based Power Distribution System" accepted for publication in *IEEE Transactions on Industrial Applications*, September, 2017.
- [J3] A.A. Milani, **M. T. A. Khan**, A.Chakraborty and I.Husain, "Equilibrium Point Analysis and Power Sharing Methods for Distribution Systems Driven by Solid-State Transformers" in *IEEE Transactions on Power Systems*, vol. PP, no. 99, pp. 1-1.

Conference Papers

- [C1] **M. T. A. Khan**, A. A. Milani, A. Chakraborty and I. Husain, "Comprehensive dynamic modeling of a solid-state transformer based power distribution system," *2016 IEEE Energy Conversion Congress and Exposition (ECCE)*, Milwaukee, WI, 2016, pp. 1-8.

- [C2] **M. T. A. Khan**, G. Norris, R. Chattopadhyay, I. Husain and S. Bhattacharya, "Auto-inspection and permitting with a PV Utility Interface (PUI) for residential plug-and-play solar photovoltaic unit," *2015 IEEE Energy Conversion Congress and Exposition (ECCE)*, Montreal, QC, 2015, pp. 5763-5770.
- [C3] **M. T. A. Khan**, I. Husain and D. Lubkeman, "Power electronic components and system installation for plug-and-play residential solar PV," *2014 IEEE Energy Conversion Congress and Exposition (ECCE)*, Pittsburgh, PA, 2014, pp. 3272-3278.
- [C4] **M. T. A. Khan**, M. R. Ahmed, S. I. Ahmed and S. I. Khan, "Design and performance analysis of water pumping using solar PV," *2nd International Conference on the Developments in Renewable Energy Technology (ICDRET 2012)*, Dhaka, 2012, pp. 1-4.
- [C5] **M. T. A. Khan**, S. M. S. Tanzil, R. Rahman and S. M. S. Alam, "Design and construction of an automatic solar tracking system," *International Conference on Electrical & Computer Engineering (ICECE 2010)*, Dhaka, 2010, pp. 326-329.

Short Papers / Posters

- [P1] **M. T. A. Khan**, A. A. Milani, A. Chakraborty and I. Husain, "Dynamic Modeling of FREEDM Power Distribution System," *2017 NC State Energy Conference, Raleigh, NC, USA*.
- [P2] **M. T. A. Khan**, A. A. Milani, A. Chakraborty and I. Husain, "Finding Sets of Feasible Equilibria for FREEDM Distribution System Operation: A Nonlinear Dynamical Approach," *2016 NSF Annual Site Visit, Tallahassee, FL, USA*.
- [P3] A. A. Milani, **M. T. A. Khan**, A. Chakraborty and I. Husain, "Power Sharing Algorithms for Feasible Operation of Multi-SST FREEDM System," *2016 NSF Annual Site Visit, Tallahassee, FL, USA*.
- [P4] **M. T. A. Khan**, A. A. Milani, A. Chakraborty and I. Husain, "Dynamic Analysis of the FREEDM System, Part I: Comprehensive State Space Modeling," *2015 NSF Annual Site Visit, Raleigh, NC, USA*.
- [P5] A. A. Milani, **M. T. A. Khan**, A. Chakraborty and I. Husain, "Dynamic Analysis of the FREEDM System, Part II: Existence, Uniqueness and Local Stability of Equilibria," *2015 NSF Annual Site Visit, Raleigh, NC, USA*.

Industrial Conference/Workshop

- [W1] A. A. Milani, **M. T. A. Khan**, A. Chakraborty and I. Husain, "Equilibrium Analysis of Power Distributions Driven by Solid-State Transformers," *2017 NSF Annual Industry Site Visit, Raleigh, NC, USA*.
- [W2] **M. T. A. Khan** and T. Tanaka, "Cost Analysis based on Site Data of Hybrid Inverter," *2016 Solar Power International, Las Vegas, NV, USA*.
- [W3] **M. T. A. Khan** and T. Tanaka, "Big Data Analysis of Hybrid Inverter," *2016 Inter Solar North America, San Francisco, CA, USA*.

Technical Reports

- [T1] **M. T. A. Khan**, A. A. Milani, A. Chakraborty and I. Husain, "System Modeling and Control, Annual Site Visit Report" *2017 NSF Annual Site Visit, Raleigh, NC, USA*.
- [T2] **M. T. A. Khan**, A. A. Milani, A. Chakraborty and I. Husain, "System Modeling and Control, Annual Site Visit Report" *2016 NSF Annual Site Visit, Tallahassee, FL, USA*.
- [T3] **M. T. A. Khan**, M. Izima and T. Tanaka, "Rapid Shutdown System for Storage Hybrid Inverter," *2016 Internal Company White Paper, Tabuchi Electric Company of America Ltd, San Jose, CA, USA*.

Thesis

Md Tanvir Arafat Khan. *Modeling and Optimization of Power Distribution System Driven by Solid-State Transformers: A Nonlinear Dynamical Approach*, PhD thesis to be submitted in August 2017, North Carolina State University, Raleigh, NC.

Md Tanvir Arafat Khan. *Modeling and Performance Analysis of DC motor with Solar Photovoltaic Panels*, Undergraduate thesis, Bangladesh University of Engineering and Technology (BUET), Dhaka, Bangladesh.

Research Projects

Distributed Control Methods for Intelligent Power Management with Moving Equilibria

Funded by: National Science Foundation (NSF)

Mentor: Iqbal Husain, and Aranya Chakraborty

The goal of this System Modeling and Control (SMC) project is to produce a convincing framework for the design and analysis of all necessary controls in the system, including feasibility, stability, power, energy, and fault managements and enable validation of the control algorithms. The Future Renewable Electric Energy Delivery and Management (FREEDM) system IPM control (voltage and frequency regulation) is implemented in a distributed manner given the small time constants of the power electronics components in the system. The IEM algorithms serve as the set-points for the FREEDM devices for energy management. Integration of control with protection allows the FREEDM System to transform the legacy distribution power system with centralized control and decoupled protection to a resilient distributed power and energy managed system.

Cost Effective Residential Plug and Play Photovoltaic System

Funded by: Department of Energy (DoE)

Mentor: Alex. Q. Huang, Iqbal Husain and Subhashish Bhattacharya

The goal of this project is to improve the electrical systems of residential solar photovoltaic (PV) systems through major innovation, refinement, and standardization to substantially reduce the unit cost of installed systems. The ultimate goal is to drive non-panel costs to below the \$0.96 / Watt 2020 SunShot target for a total installed cost below \$1.50 per Watt.

Economic Benefit and System Integration of Hybrid Residential Storage Inverter

REU Students: Tabuchi Electric Company, Japan

Mentor: Harumi McClure

The goal of this project is to understand the impact of residential hybrid inverter that connects energy storage with renewable sources. Using the available data set from the installed sites, we generated the profiles of the case studies in different states in the United States of America. Later, the tariff plans of different utility company is taken into the study to find the correlation of storage installation and payback period.

Teaching Experience

Instructor and Teaching Assistant: ECE 305 – Electric Power System (Spring '2014 and Spring'2013).

Teaching Assistant: ECE 200 – Introduction to Signals, Circuits and Systems (Spring'2013).

Lecturer: Department of Electrical Engineering, Prime Asia University, Dhaka, Bangladesh (2012).

Lecturer: Department of Electrical Engineering, Green University, Dhaka, Bangladesh (2011).

Mentoring

REU-ECE 2015: Graduate student (Likhita Ravuri).

REU-ECE 2013: Undergraduate student (Anne Bowers).

Leadership and Outreach

Vice President, Student Leadership Council (SLC), NSF FREEDM Systems Center (2015-2016).
Education and Outreach Committee Chair, SLC, NSF FREEDM Systems Center (2014-2015).
Vice President, Bangladesh Student Association (BSA), NC State University (2014-2015).
Treasurer, BSA, NC State University (2013-2014).

Professional service

Student Volunteer: ECCE 2015, Montreal, Canada.

Volunteer and Mentor: North Carolina Science Olympiad (2013-2014), Raleigh, NC.

Journal Reviewer:

- IEEE Transactions on Control Systems Technology (ICST).

Conference Reviewer: PEDG 2017, ECCE 2016, PEDG 2016.

References

Referee 1:

Dr. Iqbal Husain
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Director, FREEDM Engineering Research Center
North Carolina State University
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Referee 2:

Dr. Aranya Chakraborty
Associate Professor, Electrical & Computer Engineering
FREEDM Engineering Research Center
North Carolina State University
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Email: achakra2@ncsu.edu

Referee 3:

Dr. Pam Page Carpenter
Director of Education and Workforce Programs
FREEDM Engineering Research Center and Power America
Electrical & Computer Engineering – College of Engineering
North Carolina State University
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