OMAR A BAIG

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KEY QUALIFICATIONS

Dr. Omar A. Beg (Baig) is an Assistant Professor of Electrical Engineering at the University of Texas Permian Basin (UTPB). Previously, he was with the University of Texas at Arlington as an Assistant Professor of Research where he worked on projects funded by the Office of Naval Research. His research interests include cyber-attack detection and resilience in cyber-physical power systems using formal methods and artificial intelligence. He is the recipient of $ 4.9 Million grant by the Department of Education. He is also the recipient of a research instrumentation grant by the US Department of Defense (DoD). His aim is to promote research and education on smart grids and resilient power systems. Dr. Baig has the following key qualifications:

- As the Principal Investigator, he has secured overall $ 5.6 Million worth of grants at UTPB.
- He has over twenty years of teaching and research experience in electric power and energy systems (including smart grid, cyber-security, software-controlled power electronics, and distributed energy resources).
- Based on his significant contributions to the professions, he has been elevated to the Senior Member status by the Institute of Electrical and Electronics Engineers (IEEE), USA. It is an honor bestowed only to those who have made significant contributions to the profession.

EDUCATION AND CERTIFICATIONS

2021 **Certificate in Effective College Instructions**, *The American Council on Education and The Association of College and University Educators*, USA

2017 **Doctor of Philosophy in Electrical Engineering (CGPA: 4.0/4.0)**, *The University of Texas at Arlington*, Arlington, TX
- Dissertation: *Formal Verification of DC Distribution Networks*

2013 **Project Management Professional (PMP)**, *Project Management Institute (PMI)*, USA
Earned the certification based on the experience acquired through three research projects pertaining to power sources for Autonomous Underwater Vehicles.

2012 **Diploma in Project Management**, *National University of Sciences and Technology*

2006 **Masters in Electrical Engineering (CGPA: 3.5/4.0)**, *National University of Sciences and Technology*
- Thesis: *P*arameter Estimation Methods for Identification of Linear Time-Invariant Systems

1998 **BSEE, Electrical Engineering**, *National University of Sciences and Technology*
- Final year project: *D*esign and Development of the Heart Beat Monitor

GRANTS AND AWARDS

September 2022 **President's Research Award**, *Awarded by the UTPB President*

August 2022 **Arlen and Betty Edgar Faculty Fellowship**, *Endowed Faculty Fellowship in Engineering*

Summer 2022 **US Army Education Outreach Program - Amount $33,000**, *US Army Research Office (ARO)*

Spring 2022 **College of Engineering Outstanding Research Scholar Award**, *UTPB College of Engineering*

Fall 2021 **HSI-STEM Program - Amount $ 4.9 Million**, US Department of Education
Approved by the Department of Education to increase enrollment, retention, graduation, and skills through internships and research. The proposal aims to strengthen the STEM pipeline for the Permian Basin region.

Spring 2021 **Research Instrumentation Grant - Amount $300,000**, *US Department of Defense (DoD)*

Spring 2021 **Support Grant for Undergraduate Students - Amount $112,500**, *Texas Higher Education Coordinating Board*

Summer 2020 **Summer Faculty Research Grant at The University of Texas Permian Basin**, *Odessa, TX*

Fall 2019 **Rising STARs (Science and Technology Acquisition and Retention) Award**, The University of Texas System

2017 **PhD Dissertation Fellowship at The University of Texas at Arlington**, *Arlington, TX*

2017 **NSF Travel Awards for Cyber-Physical Systems Week - 2017 (CPS - 2017)**, *Pittsburg, PA*

2015 **NSF Travel Awards for Formal Methods in Computer-Aided Design Conference**, *Austin, TX*

Summer 2015 **Graduate Research Fellowship**, *Air Force Research Laboratory, Information Directorate*, Air Force Office of Scientific Research (AFOSR), Summer Faculty Fellowship Program (SFFP), Rome, NY

PROFESSIONAL AND RESEARCH EXPERIENCE

2021 – Present **Project Director HSI STEM**, *The University of Texas Permian Basin,* Odessa, TX

- As a PI, developed and submitted the HSI STEM project proposal to the Department of Education for approval as Title III grant during Summer 2021
- Responsible to lead, direct, and complete the project in five years with an overall amount of $ 4.9 Million
- Overall responsible to implement HSI STEM project goals (increase enrollment, retention, graduation, and skills of students and faculty)
- Involved in hiring of the project team to include the project manager, administrative assistant, and assistant director of the Student Success
- Initiated the Research Program for Undergraduates (RPU) and led the project team to effectively implement the program. Since Summer 2022, RPU supported the research projects of STEM faculty members to include stipends for faculty, stipends for student scholars, and support for research supplies
- Initiated the Internship Program for Undergraduates in coordination with the UTPB Career Services and Human Resources. This program will provide over $250,000 to support the STEM students interns in local industries for hands-on experience

8/2019 – Present **Assistant Professor**, *The University of Texas Permian Basin,* Odessa, TX

- Department Coordinator of Electrical Engineering Department since Spring 2021
- Arlen and Betty Edgar Faculty Fellow since August 2022 (Endowed Faculty Fellowship in Engineering)
- Graduate faculty member at the University of Texas at San Antonio and co-advised a doctoral student
- Academic adviser of undergraduate students at the Department of Electrical Engineering
- Mentor/adviser of IEEE Students' Chapter at The University of Texas Permian Basin during 2020
- Actively participated during annual summer camps (since 2020) at The University of Texas Permian Basin for middle and high school students. Arranged a robotics summer camp during Summer 2020 for the students to provide them hands-on training on assembling, programming, and controlling the robots
- Taught the following new courses/labs in line with the ABET guidelines:
  - Control Systems (Summer 2021)
  - Digital Circuit Design and lab (Fall 2019, Spring 2021)
  - Electromagnetic Fields (Fall 2019, Fall 2020-2021)
  - Fundamentals of Circuit Analysis lab (Fall 2019 and Fall 2020)
  - Signals and Systems (Spring 2020, Spring 2021, Fall 2021)
  - Fundamentals of Circuits Analysis (Spring 2020, Summer 2020, Spring 2021)
  - Electronic Circuit Analysis lab (Fall 2020)
  - Foundations of Electrical Engineering (Fall 2020, Fall 2021, Spring and Fall 2022)
  - Design Methodology in Electrical Engineering (Spring 2021)
- Developed the laboratory manuals for various labs and conducted the labs for the first time at The University of Texas Permian Basin. Same lab manuals are being used to conduct the labs.
- Actively participated to prepare the course description of a new course, titled as, "Foundations of Electrical Engineering" to meet the ABET accreditation requirements. Prepared the syllabus, and taught this new course during Fall 2020
- Collaborated with the members of VeriVITAL: The Verification and Validation for Intelligent and Trustworthy Autonomy Laboratory at Vanderbilt University on the reachability analysis of power systems
- Collaborated with the research groups/scholars in four universities that have significant research activities, including the University of Dayton, the University of Texas at Arlington, University of Connecticut, and the University of Texas at San Antonio on cyber-physical anomaly detection in power systems
- Led and advised research projects for Semester Undergraduate Research in Engineering (SURE) program and supervised undergraduate students since Fall 2019. The student has presented his research work during UTPB Undergraduate Research Day.
- Member of UTPB Intellectual Property Committee, Academic Transformation Advisory Committee, and various faculty/staff search committees
- Member of the departmental ABET committee and the College Curriculum Review Committee. Prepared ABET course assessment reports and updated the syllabus to bring the courses in line with ABET guidelines
- Actively participated in the outreach activities arranged for the students of local schools and community colleges, prepared the presentations and talked about the importance of engineering, conducted the lab tours and answered the questions of students and parents

2017 – 2019 **Assistant Professor of Research/Faculty Associate Researcher**, *The University of Texas at Arlington,* Arlington, TX

- Performed research activities at the Complex Power Electronics Laboratory on the research projects funded by the Office of Naval Research
- Mentored the graduate students in the laboratory, advised them on power electronics-based systems research, and guided about the technical writing of their research papers and doctoral dissertations

2014 – 2017 **Graduate Teaching/Research Assistant**, *The University of Texas at Arlington,* Arlington, TX

- Worked on the research projects funded by the US Air Force Research Laboratory, Air Force Office of Scientific Research, the Office of Naval Research, and National Science Foundation
- Member of VeriVITAL: The Verification and Validation for Intelligent and Trustworthy Autonomy Laboratory
- Installation and commissioning of cyber-physical power systems test bed composed of dSPACE Micro-Lab Boxes and Typhoon Hardware-in-the-Loop (HIL) Systems at Complex Power Electronics Laboratory
- Arranged, facilitated, and conducted outreach activities for local schools in 2016 and 2017

Summer 2015 **Graduate Research Intern**, *Air Force Research Laboratory, Information Directorate*, Air Force Office of Scientific Research (AFOSR), Summer Faculty Fellowship Program (SFFP), Rome, NY

2008 – 2013 **Senior Electrical Engineer and Project Manager for Research and Development**, *Government*

- Initiated, led, and completed various research and development projects related to power electronics
- Led the engineering team to smoothly transition the developed products from R & D prototypes to full production that met the performance, reliability, and cost targets
- Documented the systems and subsystems level control requirements from functional specifications and the safety aspects in collaboration with all the stakeholders
- Led the team during trials of the prototypes, conducted Failure Mode and Effects Analysis (FMEA) and identified the root causes of the failures, implemented technical solutions, provided design and documentation review through problem solving, resulting improved prototypes that passed the acceptance trials
- Prepared the technical progress reports for higher authorities
- Led the technical team to perform preventive and corrective maintenance of electrical equipment

2006 – 2008 **Faculty of Electrical Engineering**, *National University of Sciences and Technology*

- Taught courses pertaining to control systems, power electronics, and circuit analysis
- Performed ISO audit of the education processes and procedures
- Organized three open house (job fair) sessions for local industry
- Organized an international conference in collaboration with IEEE
- Participated in accreditation of the college from engineering accreditation authority
- Provided mentoring to the electrical engineering students
- Arranged and led the industrial visits for the engineering students

1998 – 2004 **Electrical Engineer and Training Officer**, *Government*

- Led the technical team to perform preventive and corrective maintenance of electrical equipment
- Provided mentoring and prepared comprehensive training programs for novice engineers and technicians to familiarize them with the professional environment and safe industrial practices
- Actively participated in curriculum and lesson plans development for electrical engineering courses in the training school and taught courses pertaining to control systems, power electronics, and management for engineers

PROFESSIONAL ASSOCIATIONS

Member of the following professional associations:

- Institute of Electrical and Electronics Engineers (IEEE) - Senior Member
- Project Management Institute (PMI)
- IEEE Power Electronics Society (PELS)
- IEEE Technology and Engineering Management Society
- IEEE PELS Technical Committee on Design Methodologies
- IEEE Young Professionals
- Tau Beta Pi - The Engineering Honor Society

SALIENT RESEARCH ACTIVITIES

RESEARCH PAPERS UNDER REVIEW/PREPARATION

[U2] Asad Ali Khan, ***Omar Ali Beg***, Yu-Fang Jin, and Sara Ahmed, "An Explainable Intelligent Framework for Anomaly Mitigation in Cyber-Physical Inverter-based Systems", under preparation for an IEEE journal.

[U1] Asad Ali Khan and ***Omar Ali Beg***, "Cyber Vulnerabilities of Modern Power Systems" a book chapter

in *Power Systems Cybersecurity*, Publisher: Springer Nature Switzerland AG Gewerbestrasse 11, 6330 Cham, Switzerland, accepted, proofreading completed, and is under publication process.

REFEREED JOURNAL ARTICLES

[J8] Xiaodong Yang, ***Omar Ali Beg***, Matthew Kenigsberg, and Taylor T. Johnson, "A Framework for Identification and Validation of Affine Hybrid Automata from Input-Output Traces", in *ACM Transactions on Cyber-Physical Systems*, June 2021.

[J7] Asad Ali Khan, ***Omar Ali Beg***, Miltos Alamaniotis, and Sara Ahmed "Intelligent Anomaly Identification in Cyber-physical Inverter-based Systems", in *Elsevier Electric Power Systems Research*, vol. 193, April 2021.

[J6] ***Omar Ali Beg***, Luan V. Nguyen, Taylor T. Johnson, and Ali Davoudi, "Cyber-Physical Anomaly Detection in Microgrids Using Parametric Time-Frequency Logic", in *IEEE Access*, vol. 9, pp. 20012-20021, January 2021.

[J5] Shan Zuo, ***Omar Ali Beg***, Ali Davoudi, and Frank L. Lewis, "Resilient Networked AC Microgrids Under Unbounded Cyber Attacks", in *IEEE Transactions on Smart Grid*, vol. 11, no. 5, pp. 3785-3794, Sept. 2020.

[J4] ***Omar Ali Beg***, Luan V. Nguyen, Taylor T. Johnson, and Ali Davoudi, "Signal Temporal Logic-based Attack Detection in DC Microgrids," in *IEEE Transactions on Smart Grid*, vol. 10, no. 4, pp. 3585-3595, July 2019.

[J3] ***Omar Ali Beg***, Houssam Abbas, Taylor T. Johnson, and Ali Davoudi, "Model Validation of PWM DC-DC Converters," in *IEEE Transactions on Industrial Electronics*, vol. 64, no. 9, pp. 7049-7059, Sept. 2017.

[J2] ***Omar Ali Beg***, Taylor T. Johnson, and Ali Davoudi, "Detection of False-data Injection Attacks in Cyber-Physical DC Microgrids," in *IEEE Transactions on Industrial Informatics*, vol. 13, no. 5, pp. 2693-2703, Oct. 2017.

[J1] Stanley Bak, ***Omar Ali Beg***, Sergiy Bogomolov, Taylor T. Johnson, Luan V. Nguyen, and Christian Schilling, "Hybrid Automata: From Verification to Implementation", in International Journal on Software Tools for Technology Transfer, vol. 21, no. 1, pp. 87-104 Feb. 2019 (Online Since Jun. 2017).

REFEREED CONFERENCE/WORKSHOP PROCEEDINGS PAPERS

[C6] Sohan Gyawali and ***Omar Ali Beg***, "Cyber Attacks Detection using Machine Learning in Smart Grid Systems", in *IEEE Conference on Computer Communications Workshops (INFOCOM WKSHPS)*, New York, NY, USA, 2022, pp. 1-2.

[C5] Asad Ali Khan, ***Omar Ali Beg***, and Sara Ahmed "Intelligent Anomaly Mitigation in Cyber-Physical Inverter-based Systems", in *IEEE Energy Conversion Congress and Exposition*, Vancouver, Canada, Oct. 2021.

[C4] ***Omar Ali Beg***, Ajay P. Yadav, Taylor T. Johnson, and Ali Davoudi, "Formal Online Resiliency Monitoring in Microgrids", *IEEE Resilience Week*, Salt Lake City, ID, USA, 2020, pp. 99-105.

[C3] ***Omar Ali Beg***, Luan V. Nguyen, Ali Davoudi, and Taylor T. Johnson, "Computer-Aided Formal Verification of Power Electronics Circuits," IEEE Frontiers in Analog CAD (FAC), Frankfurt, Germany, July 2017.

[C2] ***Omar Ali Beg***, Ali Davoudi, and Taylor T. Johnson, "Reachability Analysis of Transformer-Isolated DC-DC Converters (Benchmark Proposal)," 4th International Workshop on Applied Verification for Continuous and Hybrid Systems (ARCH 2017), Co-located with the Cyber-Physical Systems Week 2017, Pittsburgh, PA, April 2017.

[C1] ***Omar Ali Beg***, Ali Davoudi, and Taylor T. Johnson, "Charge Pump Phase-Locked Loops and Full Wave Rectifiers for Reachability Analysis (Benchmark Proposal)," 3rd International Workshop on Applied Verification for Continuous and Hybrid Systems (ARCH 2016), Co-located with the Cyber-Physical Systems Week 2016, Vienna, Austria, April 2016.

PRESENTATION AND TALKS

[P6] Nikita Naumov and ***Omar Ali Beg***, "Maximum Power Point Tracking and Application of Neural Networks in Photovoltaic Systems", in the Louisiana State University Shreveport Regional Student Scholars Forum, Shreveport, LA, March 2021.

[P5] ***Omar Ali Beg***, "Scalable Formal Verification of Resilient Converter-dominated MVDC Networks", in the Office of Naval Research Controls Workshop at the University of Virginia, Blacksburg, VA, 2019.

[P4] ***Omar Ali Beg***, Shankar Abhinav, and Ali Davoudi, "Resilient Microgrid Control", in the Office of Naval Research Controls Workshop, Arlington, TX, 2018.

[P3] ***Omar Ali Beg***, Ali Davoudi, and Taylor T. Johnson, "Detecting and Mitigating Cyber-Physical Attacks with Invariant Inference and Runtime Assurance", poster presentation at US Air Force Research Laboratory, Rome, NY, 2015.

[P2] ***Omar Ali Beg***, Ali Davoudi, and Taylor T. Johnson, "Formal Verification of Software-controlled Power Electronics", in US Air Force Research Laboratory Safe and Secure Systems and Software Symposium, Dayton, OH, 2015.

[P1] ***Omar Ali Beg***, Ali Davoudi, and Taylor T. Johnson, "Computer Aided Formal Verification of Power Electronics Based Cyber-physical Systems", in Formal Methods in Computer Aided Design, Austin, TX, 2015.

RESEARCH/EDUCATION PROPOSALS SUBMITTED SINCE JOINING

August 2022 **University Training and Research (UTR) Program**, US Department of Energy
Prepared and submitted this proposal during August 2022 as Co-PI.

Spring 2021 **Young Investigator Program**, Office of the Naval Research
Prepared and submitted this proposal during Spring 2021 as PI. The proposal is based on applying temporal logic and genetic algorithms to increase resilience of modern power systems against cyber intrusions.

Fall 2020 **Savannah River Nuclear Solutions, LLC**, Department of Energy
Prepared and submitted this proposal during Fall 2020 as a Co-PI. The proposal's aim is to advance and incorporate emerging Internet-of-Things (IoTs) - enabled waste management, perform real-time, on-line monitoring of the waste volume and content in a waste tank using a multi-sensor fusion approach.

Summer 2020 **Faculty Early Career Development Program (CAREER Grant)**, National Science Foundation
Prepared and submitted this proposal during Summer 2020 as PI. The proposal is based on applying techniques from formal methods to increase resilience of microgrids against cyber-attacks.

2019 **Engineering Research Center for Water Energy Nexus (WEN)**, National Science Foundation
As a Co-PI, I contributed to write the planning grant proposal for Engineering Research Center for Water Energy Nexus (WEN) at UTPB and submitted it to NSF.

VOLUNTEER ACTIVITIES

2015 – Present Reviewer of the following technical journals:
- IEEE Transactions on Smart Grid
- IEEE Transactions on Power Electronics
- IEEE Journal of Emerging and Selected Topics in Power Electronics
- IEEE Transactions on Power Systems
- IEEE Transactions on Energy Conversion
- IEEE Transactions on Circuits and Systems - I
- IEEE Transactions on Industrial Informatics
- IEEE Transactions on Industrial Electronics
- IET Control Theory and Applications
- IET Generation, Transmission, and Distribution
- IET Power Electronics
- IEEE Access

2016 – 2017 Conducted the outreach activities at The University of Texas at Arlington for local schools of the Arlington Independent School District to apprise the school kids about the importance of science, technology, and engineering education and develop their interest in this profession