

Murat Kuzlu, Ph.D.
Assistant Professor

Electrical Engineering Technology
Old Dominion University
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EDUCATION:

Ph.D., Electronics and Telecommunications Engineering, Kocaeli University, Turkey, 2010.

M.S., Electronics and Telecommunications Engineering, Kocaeli University, Turkey, 2004.

B.S., Electronics and Telecommunications Engineering, Kocaeli University, Turkey, 2001.

RESEARCH AREAS:

Smart grid, smart cities, transactive energy, demand response, home energy management, building energy management, renewable energy, electric vehicle, smart grid communications and cyber security, wireless communication and embedded systems.

EXPERIENCE:

ACADEMIC EXPERIENCE

Old Dominion University

Norfolk, Virginia

Assistant Professor, Electrical Engineering Technology

2018-Current

- Research focused on Smart Grid, Transactive Energy, Cyber Physical System and Smart Grid Communication.
- Taught three courses in the area of power engineering, and one course in the telecommunication engineering.
- Leader and developer of new specialization area: Blockchain-enabled Platform for Peer-to-Peer Energy Trading.

Virginia Tech

Arlington, Virginia

Research Assistant Professor, Advanced Research Institute

2014-2018

- Research focused on Smart Grid and Co-Simulation Platforms
- Project leader on Smart Grid/Demand Response Projects
- Organized short-term courses in the smart grid and transactive energy
- Advised graduate students

Post-Doctoral Research Fellow, Advanced Research

2011-2014

- Hardware and Software Design of Smart Plug based on MCU and ZigBee.
- Energy Monitoring and Control System Design for Demand Response Applications.
- GUI Software development for Home Energy Management System with C++

INDUSTRIAL EXPERIENCE:

Scientific and Technological Research Council of Turkey

Kocaeli, Turkey

Senior Researcher, Energy Institute

2006-2011

- Communication architecture design for smart grid applications,
- Development of data-acquisition systems for renewable energy sources,
- Project Leader on Underwater Communication System Projects,
- Software Design of Underwater Telephone with TI 55XX DSP,
- Degaussing and Ranging Systems Installation, Implementation and Hardware and Software Design for sensor data collection and monitoring,
- Software development for data analysis of Ship's Magnetic-Acoustic-Pressure Signature with Borland C++

Nortel Networks

Istanbul, Turkey

Software Design Engineer, R&D

2005-2006

- Software development for DMS 100/200/300 switching.
- Technical support for Nortel Networks customers in the whole world by fixing software originated problems and recovering.

TEACHING:

Assistant Professor, Old Dominion University, Norfolk, Virginia

August 2018 – Current

Introduction to Smart Grids (EET 483)

- Offered the first time at ODU
- Developed syllabus and class lecture

Introduction to Local Area Networks (EET 405)

- Developed syllabus, updated class lectures.

Electrical Power and Machinery (EET 360)

- Developed syllabus, revised tests, and exams.

Electrical Power and Machinery Laboratory (EET 365W)

- Developed syllabus, revised lab instructions and exams.

Before Old Dominion University

Research Assistant Professor, Virginia Tech, Arlington, VA

2014-2018

Introduction to Smart Grid

- Organized and participated in the short course for visiting students from Bahcesehir University (Turkey).

Smart Grid and Home Energy Management Technology, Software and Applications

- Co-organized and participated in the short course for visiting engineers and faculties from Yildiz Technical University (Turkey).

PAPERS:

JOURNAL PAPERS:

While at Old Dominion University:

2019 - 2020:

1. D. Bian, **M. Kuzlu**, M. Pipattanasomporn, S. Rahman and D. Shi, "Performance evaluation of communication technologies and network structure for smart grid applications," in IET Communications, vol. 13, no. 8, pp. 1025-1033, 14 5 2019. doi: 10.1049/iet-com.2018.5408
2. D. Bian, D. Shi, M. Pipattanasomporn, **M. Kuzlu** and S. Rahman, "Mitigating the Impact of Renewable Variability with Demand-Side Resources Considering Communication and Cyber Security Limitations," in IEEE Access, vol. 7, pp. 1379-1389, 2019. doi: 10.1109/ACCESS.2018.2886225

2018- 2019:

3. A. Nugur, M. Pipattanasomporn, **M. Kuzlu** and S. Rahman, "Design and Development of an IoT Gateway for Smart Building Applications," in IEEE Internet of Things Journal. doi: 10.1109/JIOT.2019.2926099
4. E. Uysal, S. Yilmaz and **M. Kuzlu**, "Digital Acoustic Modem Design for Narrowband Underwater Vehicle Communications", Journal of Marine Science and Technology 26 (4), 594-603, September 2018.

Before Old Dominion University:

5. I. Rahman, **M. Kuzlu**, S Rahman, "Power disaggregation of combined HVAC loads using supervised machine learning algorithms", Energy and Buildings 172, 57-66, April 2018.
6. **M. Kuzlu**, M. Rahman, M. Pipattanasomporn and S. Rahman, "An internet-based communication platform for residential demand response programs", IET Networks, DOI: 10.1049/iet-net.2016.0040, Available online: Jan 2017.
7. A. Saha, **M. Kuzlu**, M. Pipattanasomporn and S. Rahman, "Enabling Residential Demand Response Applications with a ZigBee-based Load Controller Systems", Intelligent Industrial Systems, Vol. 2, Iss. 4, pp. 333-318, Dec 2016.
8. Q. Wang, M. Pipattanasomporn, **M. Kuzlu**, T. Yi, Y. Li and S. Rahman, "A Framework for Vulnerability Assessment of Communication Systems for Electric Power Grids," IET Generation, Transmission & Distribution, Vol. 10, Iss. 2, pp. 477-486, Feb 2016.
9. **M. Kuzlu**, "Score-based intelligent home energy management (HEM) algorithm for demand response applications and impact of HEM operation on customer comfort", IET Generation, Transmission & Distribution, vol.9, no.7, April 2015, pp.627-635.

10. **M. Kuzlu**, M. Pipattanasomporn and S. Rahman, "Impacts of House Sizes, Appliance Ratings and Usage Patterns on Demand Response Applications: A Case-based Study," *Intelligent Industrial Systems*, Vol. 1, Iss. 4, pp. 345-357, Dec 2015.
11. A. Saha, **M. Kuzlu**, M. Pipattanasomporn, S. Rahman, O. Elma, U. S. Selamogullari, M. Uzunoglu and B. Yagcitekcin, "A Robust Building Energy Management Algorithm Validated in a Smart House Environment," *Intelligent Industrial Systems*, May 2015.
12. W. Khamphanchai, M. Pipattanasomporn, **M. Kuzlu**, J. Zhang, and S. Rahman, "An Approach for Distribution Transformer Management with a Multiagent System," *IEEE Transactions on Smart Grid*, vol.6, Iss.3, pp.1208-1218. May 2015.
13. **M. Kuzlu**, M. Pipattanasomporn and S. Rahman, "Communication Network Requirements for Major Smart Grid Applications in HAN, NAN and WAN," *Computer Networks*, vol. 67, pp. 74-88, July 2014.
14. M. Pipattanasomporn, **M. Kuzlu**, S. Rahman and Y. Teklu, "Load Profiles of Selected Major Household Appliances and Their Demand Response Opportunities," *Smart Grid, IEEE Transactions on*, vol.5, no.2, pp.742-750, March 2014.
15. **M. Kuzlu**, M. Pipattanasomporn and S. Rahman, "Hardware Demonstration of a Home Energy Management System for Demand Response Applications," *Smart Grid, IEEE Transactions on*, vol.3, no.4, pp.1704-1711, Dec. 2012.
16. M. Pipattanasomporn, **M. Kuzlu** and S. Rahman, "An Algorithm for Intelligent Home Energy Management and Demand Response Analysis," *Smart Grid, IEEE Transactions on*, vol.3, no.4, pp.2166-2173, Dec. 2012.
17. **M. Kuzlu**, H. Dincer and S. Ozturk, "DSP Implementation of Underwater Communication Using SSB Modulation with Random Carrier Frequencies", *Scientific Research and Essays*, vol. 5, no. 10, pp. 1084-1099, May 2010.

CONFERENCE PAPERS (PEER REVIEWED):

While at Old Dominion University:

2019-2020

1. **M. Kuzlu**, M. Pipattanasomporn, L. Gurses and S. Rahman, "Performance Analysis of a Hyperledger Fabric Blockchain Framework: Throughput, Latency and Scalability," in *Proc. 2th IEEE International Conference on Blockchain*, July 14-17, 2019, Atlanta, GA.
2. M. Pipattanasomporn, S. Rahman and **M. Kuzlu**, "Blockchain-based Solar Electricity Exchange: Conceptual Architecture and Laboratory Setup," *2019 IEEE Power & Energy Society Innovative Smart Grid Technologies Conference (ISGT)*, Washington, DC, USA, 2019, pp. 1-5. doi: 10.1109/ISGT.2019.8791663
3. E. Bingöl, **M. Kuzlu** and M. Pipattanasomporn, "A LoRa-based Smart Streetlighting System for Smart Cities," *2019 7th International Istanbul Smart Grids and Cities Congress and Fair (ICSG)*, Istanbul, Turkey, 2019, pp. 66-70. doi: 10.1109/SGCF.2019.8782413. (Received the best paper award in ICSG İstanbul 2019).

2018-2019

4. M. Pipattanasomporn, **M. Kuzlu** and S. Rahman, "A Blockchain-based Platform for Exchange of Solar Energy: Laboratory-scale Implementation," In *Proc. ICUE 2018 on Green Energy for Sustainable Development*, Phuket, Thailand, October 24-26, 2018.
5. **M. Kuzlu**, M. Pipattanasomporn and S. Rahman, "Assessment of Communication Technologies Supporting Smart Streetlighting Applications," in *Proc. 4th IEEE International Smart Cities Conference (ISC2)*, September 16-19, 2018, Kansas City, MO.

Before Old Dominion University:

6. M. Kuzlu, M. Pipattanasomporn, S. Rahman, "A Comprehensive Review of Smart Grid Related Standards and Protocols", International Istanbul Smart Grid Congress and Fair (ICSG), Turkey, Apr 19-21, 2017
7. A. Alfadda, R. Adhikari, M. Kuzlu, and S. Rahman, "Hour-Ahead Solar PV Power Forecasting using SVR Based Approach", Accepted for presentation at the IEEE ISGT 2017, Washington, D.C., Apr 23-26, 2017.
8. R. Adhikari, X. Zhang, M. Pipattanasomporn, M. Kuzlu and S. Rahman, "A Data-driven Approach for Quantifying Energy Savings in a Smart Building", Accepted for presentation at the IEEE ISGT 2017, Washington, D.C., Apr 23-26, 2017.
9. K. Rathinavel, M. Pipattanasomporn, M. Kuzlu and S. Rahman, "Security Concerns and Countermeasures in IoT-Integrated Smart Buildings", Accepted for presentation at the IEEE ISGT 2017, Washington, D.C., Apr 23-26, 2017.
10. X. Zhang, R. Adhikari, M. Pipattanasomporn, M. Kuzlu and S. Rahman, "Deploying IoT devices to make buildings smart: Performance evaluation and deployment experience", In Proc. the IEEE World Forum on Internet of Things, Washington, D.C., Dec 12-14, 2016.
11. R. Adhikari, M. Pipattanasomporn, M. Kuzlu, and S. Rahman, "Simulation study of transactive control strategies for residential HVAC systems", Accepted for presentation at the ISGT Europe. Ljubljana, Slovenia, Oct 9-12, 2016.
12. X. Zhang, M. Pipattanasomporn, M. Kuzlu, and S. Rahman, "Conceptual Framework for a Multi-building Peak Load Management System", Accepted for presentation at the ISGT Europe. Ljubljana, Slovenia, Oct 9-12, 2016.
13. S. Ramdasapalli, M. Pipattanasomporn, M. Kuzlu, and S. Rahman, "Transactive Control for an Efficient Operation of Commercial Buildings", Accepted for presentation at the ISGT Europe. Ljubljana, Slovenia, Oct 9-12, 2016.
14. A. Shen, M. Kuzlu, M. Pipattanasomporn, S. Rahman and L. Chen, "A performance testing method for embedded software platforms," 2016 IEEE International Conference on Cyber Technology in Automation, Control, and Intelligent Systems (CYBER), Chengdu, China, 2016, pp. 135-140.
15. A. Dogan, M. Kuzlu, M. Pipattanasomporn and S. Rahman, "Impact of EV charging strategies on peak demand reduction and load factor improvement", Presented at the 9th International Conference on Electrical and Electronics Engineering (ELECO), Bursa, Turkey, Nov 26-28, 2015.
16. M. Kuzlu, M. Pipattanasomporn, and S. Rahman, "Review of communication technologies for smart homes/building applications", Presented at the IEEE ISGT Asia. Bangkok, Thailand, Nov 4-6, 2015.
17. M. Pipattanasomporn, M. Kuzlu, W. Khamphanchai, A. Saha, K. Rathinavel and S. Rahman, "BEMOSS: an agent platform to facilitate grid-interactive building operation with IoT devices", Presented at the IEEE ISGT Asia. Bangkok, Thailand, Nov 4-6, 2015.
18. W. Khamphanchai, M. Pipattanasomporn, M. Kuzlu and S. Rahman, "An agent-based open source platform for building energy management", Presented at the IEEE ISGT Asia. Bangkok, Thailand, Nov 4-6, 2015.
19. Q. Wang, M. Pipattanasomporn, M. Kuzlu, Y. Tang, Y. Li and S. Rahman, "Impact assessment of communication service disruptions in power system applications", In Proc. the IEEE PES GM Conference. Denver, CO, July 26-30, 2015.
20. D. Bian, M. Kuzlu, M. Pipattanasomporn, S. Rahman and Y. Wu, "Real-time co-simulation platform using OPAL-RT and OPNET for analyzing smart grid performance", In Proc. the IEEE PES GM Conference. Denver, CO, July 26-30, 2015.

21. W. Khamphanchai, A. Saha, K. Rathinavel, M. Kuzlu, M. Pipattanasomporn, S. Rahman, B. Akyol, and J. Haack, "Conceptual Architecture of Building Energy Management Open Source Software (BEMOSS)", In Proc. at the IEEE PES ISGT-Europe Conference. Istanbul, Turkey, October 12-15, 2014.
22. A. Saha, S. Rahman, M. Pipattanasomporn and M. Kuzlu, "On Security of a Home Energy Management System", In Proc. at the IEEE PES ISGT-Europe Conference. Istanbul, Turkey, October 12-15, 2014.
23. A. Saha, M. Kuzlu, W. Khamphanchai, M. Pipattanasomporn, S. Rahman, O. Elma, U.S. Selamogullari, M. Uzunoglu and B. Yagcitekcin, "A Home Energy Management Algorithm in a Smart House Integrated with Renewable Energy", In Proc. the IEEE PES ISGT-Europe Conference. Istanbul, Turkey, October 12-15, 2014.
24. D. Bian, M. Kuzlu, M. Pipattanasomporn and S. Rahman, "Analysis of Communication Schemes for Advanced Metering Infrastructure (AMI)", In Proc. IEEE PES General Meeting Conference (GM 2014), Washington, D.C., July 2014.
25. D. Bian, M. Kuzlu, M. Pipattanasomporn, and S. Rahman, "Assessment of Communication Technologies for a Home Energy Management System", In Proc. IEEE PES ISGT Conference, Washington DC, February 19-22, 2014.
26. M. Rahman, M. Kuzlu, M. Pipattanasomporn, and S. Rahman, "Architecture of Web Services Interface for a Home Energy Management System", In Proc. IEEE PES ISGT Conference, Washington DC, February 19-22, 2014.
27. A. Saha, M. Kuzlu and M. Pipattanasomporn, "Demonstration of a home energy management system with smart thermostat control," In Proc. 2013 IEEE PES Innovative Smart Grid Technologies (ISGT), Washington, D.C., 24-27 Feb. 2013.
28. M. Kuzlu and M. Pipattanasomporn, "Assessment of communication technologies and network requirements for different smart grid applications," In Proc. 2013 IEEE PES Innovative Smart Grid Technologies (ISGT), Washington, D.C., 24-27 Feb. 2013.
29. W. Khamphanchai, M. Kuzlu and M. Pipattanasomporn, "A smart distribution transformer management with multi-agent technologies," In Proc. 2013 IEEE PES Innovative Smart Grid Technologies (ISGT), Washington, D.C., 24-27 Feb. 2013.
30. M. Pipattanasomporn, M. Kuzlu and S. Rahman, "Demand response implementation in a home area network: A conceptual hardware architecture," In Proc. 2012 IEEE PES Innovative Smart Grid Technologies (ISGT), Washington, D.C., 16-20 Jan. 2012.
31. M. Kuzlu, M. Hasan, S. Rahman and H. Dincer, "Design of Wireless Smart Metering System Based On MSP430 MCU and ZigBee for Residential Application", 7th International Conference on Electrical and Electronics Engineering (ELECO 2011), Turkey, December 2011.
32. H. Dincer, F. Mutlu and M. Kuzlu, "Integration of Digital Technology to Power Grid Network: Smart Grid", 4th Energy Efficiency and Quality Symposium (EVK 2011), Turkey, May 2011.
33. M. Kuzlu, H. Dincer, S. Ozturk and T. Kadioglu, "Real Time Implementation of Digital Band Pass Analytic Filter Pair", 6th National Conference on Electrical, Electronics and Computer Engineering (ELECO 2010), Turkey, December 2010.
34. T. Kadioglu, H. Dincer and M. Kuzlu, "Localization in Wireless Sensor Networks", 6th National Conference on Electrical, Electronics and Computer Engineering (ELECO 2010), Turkey, December 2010.
35. M. Kuzlu, M. Şengul, A. Kiliç, H. Dincer, I. Yaglidere and S.B. Yarman, "Design of Impedance Matching Network for B&K 8104 Hydrophone Via Direct Computational Technique for Underwater Communication", 10th Mediterranean Microwave Symposium MMS 2010, Cyprus, August 2010.
36. E. Uysal, S. Yilmaz and M. Kuzlu, "Digital Underwater Communication System Design with DSP", 10th European Conference on Underwater Acoustics ECUA 2010, Turkey, July 2010.

37. M. Kuzlu, H. Dincer and S. Ozturk, “Design of an Underwater Communication Receiver Pre-Amplifier”, 18th IEEE Signal Processing and Communications Applications Conference (SIU 2010), Turkey, April 2010.
38. M. Kuzlu and H. Dincer, “Implementation of underwater communication with TMS320VC5509A DSK”, 6th International Conference on Electrical and Electronics Engineering (ELECO 2009), pp.199-203, November 2009.
39. E. Vural, H. Dincer, S. Ozturk and M. Kuzlu, “Applications and Principles of WiMAX”, 3th Communication Technologies and Applications Symposium (HABTEKUS 2009), Turkey, December 2009.
40. M. Kuzlu, H. Dincer, S. Ozturk and E. Vural, “DSP Implementation of Underwater Communication with Using Random Carrier Frequencies,” 3th Communication Technologies and Applications Symposium (HABTEKUS 2009), Turkey, December 2009.
41. E. Cekli, A. Yilmaz, M. Kuzlu, and Y. Izgi, “DSP Implementation of Underwater Communication”, 5th National Conference on Electrical, Electronics and Computer Engineering (ELECO 2008), Turkey, November 2008.
42. Y. Izgi, E. Cekli, M. Kuzlu, E. Uysal, “Reducing Ship’s Magnetic Signature with Coil Current Optimization Method”, 5th National Conference on Electrical, Electronics and Computer Engineering (ELECO 2008), Turkey, November 2008.

GRANTS AWARDED:

2019 -2020

1. **Department of Education (ED)**, “*Computer Science Principles and Cybersecurity Pathway for Career and Technical Education*”. Total period covered: 10/01/2019 – 09/30/2022. PI: V. Jovanovic. Total amount awarded: 450,000.00, Personal Contribution 20% 90,000.00.
2. **Virginia Space Grant Consortium (VSGC)**, “*Development of Intelligent Algorithms for Control of Energy Resources and Loads to Enhance Energy Sustainability for the International Space Station*”. Total period covered: 06/01/2019 – 05/09/2020. PI: M. Kuzlu. Total amount awarded: 10,000.00, Personal Contribution 100% 10,000.00.

2018 -2019

3. **BEM Controls (DoE – STTR Phase I)**, “*Blockchain-enabled Peer-to-Peer Energy Trading Platform for Managing Complex Exchange of Kilowatt-hours and Negawatts*”. Total period covered: 10/10/2018 – 04/09/2019. PI: M. Kuzlu. Total amount awarded: 55,089.00, Personal Contribution 100% 55,089.00.

Before Old Dominion University:

4. **U.S. National Science Foundation:** “*Mapping Industrial Control Systems*”. Total period covered: 07/01/2016 – 08/01/2017, PI – Kevin Heaslip and co-PI – M. Kuzlu, Total amount awarded: \$150,000.
5. **U.S. National Science Foundation:** “*STTR Phase I: An Agent-based Self-learning Technology for Efficient Building Operations and Automated Participation in Electricity Markets*”. Total period covered: 07/01/2016 – 10/01/2016, PI – M. Pipattanasomporn and co-PI – M. Kuzlu, Total amount awarded: \$ 224,673.

6. **Qatar Foundation:** *“Qatar Power System Transition to a Smart Grid”*. Total period covered 07/01/ 2014 – 12/01/2015, PI – S. Rahman, Total amount awarded: \$300,000.
7. **U.S. Department of Energy:** *“Building Energy Management Open Source Software (BEMOSS)”*. Total period covered: 11/01/2013 – 10/01/2016, PI – S. Rahman and co-PI – M. Pipattanasomporn, Total amount awarded: \$1,987,895.
8. **U.S. National Science Foundation:** *“Partnerships for Innovation: Role of the Smart Grid in Alleviating Electrical Power System Stress Conditions through Demand Response”*. Total period covered: September 2011 – September 2013, PI – S. Rahman and co-PI – J. Bohland and M. Pipattanasomporn. Total amount awarded: \$699,969.

CONSULTING ACTIVITIES:

While at Old Dominion University:

Black&Veatch, Overland Park, KS: Load Forecasting Expert Summer 2019

Before Old Dominion University:

BEMControls, Arlington, VA: Smart City Lighting System Design Summer 2018

HONORS, AWARDS AND PRIZES:

Best Paper Prize, 7th International Istanbul Smart Grids and Cities Congress (ICSG) April 2019
 Best Paper Prize, 10th Mediterranean Microwave Symposium MMS 2010 July 2010
 IEEE Senior Member December 2014

MEMBERSHIP IN PROFESSIONAL SOCIETIES:

The Institute of Electrical and Electronics Engineers (IEEE) 2011- Current
 Association of Energy Engineers (AEE) 2019- Current

UNIVERSITY SERVICE:

Assistant Professor, Old Dominion University, Norfolk, Virginia July 2018 – Current

School Year 2019-2020:

- DEPT: Lab Safety

School Year 2018-2019:

- DEPT: Teaching Portfolio Evaluation Committee
- DEPT: Information Technology Committee

PROFESSIONAL SERVICE:

Conference Organizing:

- Local Organizing Committee, 2017 IEEE PES Conference on Innovative Smart Grid Technologies (ISGT), Washington, D.C., April 2017.
- Local Organizing Committee, 2015 IEEE PES Conference on Innovative Smart Grid Technologies (ISGT), Washington, D.C., February 2015.
- Local Organizing Committee, 2014 IEEE PES Conference on Innovative Smart Grid Technologies (ISGT), Washington, D.C., February 2014.
- Local Organizing Committee, 2013 IEEE PES Conference on Innovative Smart Grid Technologies (ISGT), Washington, D.C., February 2013.

Committee Member:

- IEEE Sensors Council AdCom - Power and Energy Society, 2018-Current
- Secretary, IEEE, the IEEE Hampton Road Chapter, 2018-Current.
- Treasurer, IEEE – Power & Energy Society, the IEEE Northern Virginia Section, 2016-Current.

REVIEWER:

Conferences:

6th International Conference on Control Engineering & Information Technology (CEIT) 2018
IEEE Wireless Communications and Networking Conference 2018
Technology, Knowledge, and Society (TENCON) 2015
IEEE Innovative Smart Grid Technologies (ISGT) 2013, 2014, 2015, 2017

Journals:

IEEE Transactions on Power Systems.
IEEE Transactions on Smart Grid.
IEEE Transactions on Sustainable Energy.
International Transactions on Electrical Energy Systems
Electrical Engineering
ACM Transactions on Design Automation of Electronic Systems (TODAES)
IEEE Wireless Magazine
Applied Energy
Telecommunication Systems
Electric Power Systems Research

PROFESSIONAL DEVELOPMENT

While at ODU:

- Blackboard Learning Workshop
- Summer 2019 Improving Disciplinary Writing (IDW) Faculty Workshop

Software and Programming Language Skills:

- Simulation software: Matlab/Simulink, GridLAB-D
- Real-time simulation platform: Opal-RT
- Communication simulation software: OPNET
- Programming language: C, C++, Delphi, Python
- Hardware: Orcad Schematic, Orcad Layout,
- Embedded Systems: Code Composer Studio, MPLAB, IAR MSP430.
- Experience with TI 55XX/67XX DSPs, PIC16XX/18XX, MSP430, NI DAQ, Digi XBee.

Certificates:

- Cisco Certified Network Associate –CCNA
- Cisco Certified Design Associate –CCDA
- Cisco IP Telephony Design Specialist – CQS-CIPTDS
- Microsoft Certified Professional –MCP

- Microsoft Certified Systems Engineer- MCSE W2Kserver