Mehrdad Babazadeh, Ph.D.

Assistant Professor at Uni. Zanjan

Profile Summary:

I have a lot of experience in both academia and industry. As a full-time Assistant professor at the University of Zanjan, I have thought graduate and undergraduate courses and conducted lots of research in the area of electrical engineering. On the industry side, I have over 15 years of high-level R&D experience in the area of Power Electronics, Control Systems, Wind Power Plant Control, IoT, Wireless Sensor Networks, Embedded Systems, Power Systems Protection, Modeling, and Programming. I have got my *proficiency* and knowledge from highly prestigious companies and institutions across the globe, including Imperial College London (UK), Vestas (The highest-ranked company across the globe in the area of wind energy, Denmark), Institute of Micro-sensors, actuators, and Systems (Germany), and a Regional Electricity Company (Iran).

I am also the CEO and the founder of Green Power Control Co. LTD, a start-up company in the area of IoT, Measurement, and control.

Education

Post-doc. | SEP. 2016-AUG. 2017 | IMPERIAL COLLEGE LONDON/UK

- o **Project:** *[Funded by Japan's NEC]*
  - **Implementation of Anomaly Detection on Smart Water Networks (Cyber-physical systems)**
    The Linux-based Contiki and Code Composer Studio, CCS used for programming TI tags (cc2650) to measure and communicate with different protocols (TCP-IP and UDP) in a star topology. In the next step, Arduino 101 was used for multi-thread programming of Edge Anomaly detection and the wide range LoRa module, SX1276 for communication. A well-known lossless compression algorithm (LZO) was successfully Implemented for the first time on the proposed low memory processor and developed to realize anomaly detection based on the data compression rate.

PH.D. | 2007-2010 **|**, INSTITUTE FOR MICROSENSORS, ACTUATORS AND SYSTEMS (IMSAS) – UNIVERSITY OF BREMEN/GERMANY

- o ***Thesis Title: (Grey-box Modelling): Plausibility check and energy management in a semi-autonomous wireless sensor network using a model-based approach.*** *[Intelligent Container Funded by the German food industry]*

  This Ph.D. research work carried out both energy aspects and model-based fault detection by using a wireless sensor network (WSN). The corresponding sensor nodes of the WSN were randomly scattered inside a closed space container to evaluate environmental variables, temperature, and relative humidity. A novel idea, proposed in this research, the so-called Floating Input Approach (FIA) exploited system identification as well as the properties of a WSN to simplify the modeling task in this nonlinear, multivariable, and time-variant system. This approach was implemented on the IMOTE-2 platform and utilized for model-based fault detection as well as prolonging the lifetime of the wireless sensor nodes in practice. The great achievement of this project was designing a system to detect more

than 20 types of abrupt and incipient sensor and system faults and to save more than 50% of power consumption within WSN.

MSC. **|** 1997-2000 **|,** UNIVERSITY OF TEHRAN, IRAN

o *Thesis Title: Design and implementation of Robust adaptive speed control of high-power 3_ phase AC motor by 12-pulse current source inverter (CSI) with Minimum Control Synthesis (MCS) method*

A new method, minimal control synthesis implemented on a motor drive system. Field-oriented model of a three-phase high-power asynchronous motor drived by a CSI to offer a decoupled control of flux and torque. A 12-pulse CSI was implemented as the driver of the system with SCRs. The MCS method was developed in a closed-loop configuration in the form of a high-performance model reference adaptive controller of rotor speed in a wide range. As a result, the MCS matured on 12-pulse CSIs for the first time with high performance.

BSC. **|** 1988-199**4** **|,** IRAN UNIVERSITY OF SCIENCE & TECHNOLOGY (IUST)

o *Thesis Title: Design and implementation of a wide frequency range three-phase SPWM voltage source inverter (VSI) by Isolated Gate Bipolar Transistors (IGBTs)*

A series of different flexible and low THD sinusoidal pulse width modulation (SPWM) techniques were implemented by using a programmed EPROM to generate gate pulses to feed a three-phase VSI system. It became a proven tool for any type of PWM-based converters.

Experience

Assistant Professor | 2012-PRESENT, EXCEPT FOR SEP.2016-AUG.2017|, UNI. ZANJAN/IRAN
Part-time Lecturer | 2000-2003 |, UNI. ZANJAN/IRAN

o *Teaching:*
Power Electronics (10 terms- more than 400 Students)- System Identification and modeling (to Master and Ph.D. students for 9 terms) - Adaptive Control (to Master and Ph.D. students for 6 terms)- Linear control systems (4 terms- more than 120 students)- Engineering math. (3 terms)- Digital control systems (8 terms: more than 300 students)- Electric circuits analysis (1 term)- Linear Control system Lab. (18 times)- Control, monitoring, and alarms in substations (1 term) – Industrial control (6 terms)- Electric circuits lab (8 terms), Multivariable Control (1 term).

o *Supervising MSc projects (finished):*
• Identify and modeling of plant growth rate using image processing with discrete wavelet transform, Uni. Zanjan/Iran, **|**2022**|**.
• Design and implementation of a Smart LoRa-based fire detection algorithm from aerial imagery, Uni. Zanjan/Iran, **|**2022**|**.
• Fuzzy adaptive localization of Jamming attacker based on SNR in a Wireless Sensor Network. , Uni. Zanjan/Iran, **|**2022**|**.
• Fractional order control of a Buck-converter, Uni. Zanjan/Iran, **|**2021**|**.
• Optimal active power dispatcher, Uni. Zanjan/Iran, **|**2017**|**, One paper was published.

- Harmonic evaluation in a distribution network beside wind power plants, Uni. Zanjan/Iran, |2016|, One paper was published. [A*ttracted research funding from Zanjan Regional Electricity Company (ZREC)].*
- Wind estimation in high altitudes, Uni. Zanjan/Iran, |2015|, Three papers published. *[Supposed to attract research fund from Ministry of Energy].*
- Energy-saving by using a floating input approach in a wireless sensor network. Ishwar Lal, Uni. Bremen/Germany, |2009|, One paper was published. *[Fund from the German food industry].*
- Design and implementation of two channels, n-step ahead predictor, Hochschule Bremen/Germany, |2009|.

o *Advising MSc projects (finished):*

- Simulation, modeling, and control of Induction motor based on the dissipation model.
- Sliding Mode Control Design of Impedance Source Inverter to Reduce the Current Ripple
- Fault Detection and Isolation by using a sliding mode control strategy.
- Robust control design for uncertain, delayed systems with multi-directional uncertainties.

o *Supervising BSc projects (finished):*

Indoor Localization by using footprint method | LocaGeographical Localization by using SIM868 | Optimization of LoRa Networks payload using Channel changing | Implementation of Matlab Real-time for Adaptive speed Control of DC Motor | Implementation of an smart sun-tracker by using Arduino | Implementation of LoRa messenger | Implementation of an IoT system to monitor data on the WEB | Implementation of Labview as a central platform of a LoRa-based wireless sensor network | Implementation of an inventory sun tracker by using image processing | Implementation of a wireless sensor network for photo capturing and communication by Arduino101-LoRa | Modeling rotating cylinder for granular flow | Design and implementation of a GUI for environmental sensor monitoring | Design and implementation of a 1-phase cyclo-converter programmable controller by using Arduino101 | Modeling Ni-Ion battery life time | Audio transmission by LoRa | Design of a boost converter to supply LoRa-based Wireless Sensor nodes | Fractional Order Control Systems | Temperature control design by using Flow Code | Robot's Arms Control | Full controlled AC-DC PWM converter using PLC | Full controlled 3 phase PWM inverter using PLC | Fault detection in power Rectifiers | Low Power wind turbine evaluation study | Fault detection in power Inverters | Matrix Converter | Different PWM methods in Inverter implementations and analysis | Design of Hybrid renewable systems' monitoring and control, 2014 | Siahpoush Wind Farm Modeling, 2015 | Remote DC-Motor speed control systems using smith predictor | Wireless sensor network simulator, 2015 | Implementation of PWM rectifier with PLC 93225, 2015 | Design and implementation of DC-motor speed estimator by a microcontroller "μ8751" | System estimator and PID controller design software by MATLAB | Design and implementation of digital DC motor speed controller with optic speed sensor (P.C based) | Design and implementation of Off-Line U.P.S by a microcontroller "μ8751".

Co-founder of a Startup | 2012-PRESENT |, GREEN POWER CONTROL CO. LTD

- o *Projects:*
  - **(Software): Applied Relay Coordinator, ARCO to coordinate O/C and E/F relays**
    - **Achievement:** A huge practical software program was developed and two journal papers were published based on that. The older version was continuously used for more than a decade in Zanjan Regional Electricity Company in Iran for a daily basis power system relays coordination. Further, ARCO could get technical licenses from the Iran High Council of Informatics and Innovation and Prosperity Fund, etc.
      - **Link:** https://www.youtube.com/watch?v=y9rTKCOhlck
  - **(Software/hardware): Implementation of an STM32-LoRa-based wireless sensor network for fault detection in distributed systems with application in a variety of fields such as smart agriculture, Smart cities, Wind Energy, Environmental monitoring, etc.**
    - **Achievement:** A capable ultra-low-power, edge-based, long-range wireless sensor network to be implemented for gathering sensor data and fault detection in distributed systems. It could get a technical license from the Innovation and Prosperity Fund.
      - **Links:** see relevant videos in:
        https://www.youtube.com/channel/UCVba5nCgpdkoRoFx9knImzQ

Wind Power Plant Control Lead Engineer | 2010-2012 |, VESTAS, DENMARK

Distinguished Simulink models of whole wind power Plant [STATCOM, CAP-Bank, Power Electronics, Turbines, Communications, Load, Grid, and the Power Plant Controller (PPC)] created. The models became the source for other studies and models accelerated other developments. Making informative technical documents such as the Implementation and design descriptions enabled other parties to enhance the quality of the technical analysis. Furthermore, three US patents were published. Besides, an important timing issue of a new product was figured out and resolved to organize great teamwork.

- o *Booklets provided for "Vestas"* *{Confidential (C), Public (P), Restricted(R)}:*
  - Implementation description for the modeling wind power plant controller (PPC)– Version 3, 4 (C)
  - Active power controller design description – Version 0, 1 (C)
  - VESTAS power plant performance class II – Version 1, 2 (R)
  - WPP sales document class I– Version 0, 1 (P)
  - Alarm & events in SCADA – Version 0 (C)
  - Reactive power controller design description– Version 0 (C)
  - Active power modeling. contribution in some relevant lab tests. (C)
  - Guide for WPP commissioning manual (R)
  - WPP commissioning checklist (R)
  - PPC function and grid performance (R)
  - Turbine range support verification – Version 0
  - Risk assessment for WPP commissioning checklist (R)
  - Risk assessment for commissioning manual WPP (R)
  - DVPR_DVRE for PPC requirements verified by the review (C)
  - Test case for P-Dispatcher in DVPR (C)
  - Control architecture as well as other related diagrams. (C)

Manager | 2005-2007 |, POWER SYSTEM PLANNING SECTOR, ZANJAN REGIONAL ELECTRIC CO. (ZREC)

With excellent teamwork, several important substations (400 kV, 230 kV, 63 kV) were planned. They are among the important parts of the Iranian power system now.

- o *Extra Project:*
  - Overcurrent and Earth fault mechanization Program, OEMP, [*Attracted research funding from industry Zanjan Regional Electricity Company (ZREC)].*

Expert in Power System Study & Protective Relays | 2000-2005 |, ZREC

In addition to studying a large grid and calculating protective relay settings, several software programs were created innovatively for relay coordination studies. They promoted the company by making a huge improvement in the reliability of the power system grid during the last decade.

- o *Extra Projects:*
  - Relay mechanization Program, RMP. Used effectively for more than 16 years by ZREC, [A*attracted research funding from industry Zanjan Regional Electricity Company (ZREC)].*
  - Distance Relay mechanization Program, DMP. Used for more than 15 years by ZREC, [*Attracted research funding from industry Zanjan Regional Electricity Company (ZREC)].*

Specialist & Designer | 1995-2000 |, POWER ELECTRONIC RESEARCH CENTER & A PRIVATE COMPANY

- o *Projects:*
  - **Design and implementations:**
    - A classic speed controller of 3-Phase AC motor by 12-pulse CSI.
    - A robust adaptive, high-power advanced speed controller of 3-Phase AC motor by 12-pulse CSI (DC-AC), *[Attracted research funding from Power Electronics research center/ Iran].*
    - A DC-DC Converter, fly-back Switch Mode Power Supply (SMPS), *[Attracted research funding from Power Electronics research center/ Iran].*
    - A Variable voltage/Variable frequency 1-Phase Cyclo-converter.
    - Multiple Control and Power Electronics systems.
  - **Software developments:**
    - Electrical circuit analyzing Software Program.
    - Short circuit analyzing Software Program, *[Attracted research funding from Niroo Research center/ Iran].*

US Patents (published)

- o **Wind power plant control system and method of controlling wind power plant**

  The United States Patent number: US9822765, Issued November 21, 2017.
  Inventors: ***Mehrdad Babazadeh***, *K. Nayebi.*

- o **A method of determining individual set points in a wind power plant controller (Dispatcher 2)**

  The United States Patent number: US9556852, Issued Jan 31, 2017.
  Inventors: ***Mehrdad Babazadeh***, *et al.*

- o **A method of determining individual set points in a wind power plant controller (Dispatcher 1)**

  The United States Patent number: US9407186, Issued August 2, 2016.
  Inventors: ***Mehrdad Babazadeh***, *et al.*

- **SmartEye, a LoRa-based, edge-processing monitoring system. (Being filed)**

Honors and Awards

- Outstanding technologist of Faculty of Engineering at Uni. Zanjan, 2021.
- Number one in teaching quality among all 39 members of the Electrical Engineering department at Uni. Zanjan/Iran, 2021.
- Outstanding technologist among all participants in different universities and research centers in Zanjan province in Iran, 2018.
- Outstanding reviewer, ISA Transaction, ELSEVIER, 2018.
- Among the top 10 selected industrial projects, Imperial College London/UK, 2017.
- Recipient of Vestas three Patent Filed Awards and Grant Awards for three US Patents.
- Best Paper Award of the Session at ICAT'15/Turkey, August 2015.
- Best Presentation Award, Log Dynamics International Conference (Doctoral workshop), "Plausibility check and energy management in a sensor network using a model-based approach", Uni. Bremen/Germany, August 2009.
- Publication Golden Award, "A Mechanisation program for distance relays", Electric Protection Seminar (EPS 2002), Tehran/Iran.
- Publication Golden Award, "A Practical method for harmonic distortion reduction", EPS 2000, Tehran/Iran.
- Ranked 54 out of 4500 in the M.Sc. national entrance exam (among the top 1.2 %), Iran, 1997.
- Ranked 257 out of 14881 in the B.Sc. entrance exam (among the top 1.7 %), Iran, 1988.

Some of Pogramming languages, software programs, and hardware platforms I frequently use:

- C, C++, C#, Matlab, SimScape for modelling , Vb.net,
- Altium designer, Labview
- ARM based embedded systems, Arduino, STM32

Links:

Linkedin: https://www.linkedin.com/in/mehrdad-babazadeh-phd-27584755/

Youtube Channel: https://www.youtube.com/channel/UCVba5nCgpdkoRoFx9knImzQ

Publications

- *Journal papers (under review):*

14	**"Adaptive integral-type terminal sliding mode tracker based on active disturbance rejection for uncertain nonlinear systems with input saturation";** ISA Transactions**, Under review.** Hamede Karami, Saleh Mobayyen, **Mehrdad Babazadeh.**
13	**"Smart order hold for Digital Control systems";** Iranian Journal of Electrical and Computer Engineering**. Under review.** Mehdi Shakeri**, Mehrdad Babazadeh.**
12	**"Non-Linear LCL Filter Structure for Minimizing the Amplitude of the Corner Frequency";** IEEE TRANSACTIONS ON INDUSTRIAL ELECTRONICS. **Under review.** Saeid Nouri*, Mohammad Bayat, Rahim SamanBakhsh, Asgar Taheri, **Mehrdad Babazadeh**

- *Journal papers (Published):*

11	"Toward an extreme low-power, edge-based LoRa node for monitoring/anomaly detection"; Ad Hoc & Sensor Wireless Networks Volume 54, May. 2022, P47-68. **Mehrdad Babazadeh**
10	**"Dynamical modeling of granular flow in inclined rotary drums";** Journal of Engineering Research Express. June. 2020. **Mehrdad Babazadeh,** Kianoosh Karimi, Leila Taqiloo, M.Reza Yousefi,
9	**"LoRa-based anomaly detection platform: Center and Sensor-side";** IEEE Sensors Journal, Feb. 2020**.** **Mehrdad Babazadeh.**
8	**"Edge analytics for anomaly detection in water networks by an Arduino101-LoRa based WSN";** ISA Transaction, ELSEVIER, 2019. Volume 92, Sep.2019, P273-285. **Mehrdad Babazadeh.**
7	**"Development of an Arduino101-LoRa based wind speed estimator";** Journal of Measurement, ELSEVIER, Volume 146, November 2019, P241-253. **Mehrdad Babazadeh,** Kianoosh Karimi.
6	**"Optimal Control of EGR System in Gasoline Engine Based on Gaussian Process";** IFAC-PapersOnLine 50 (1), ELSEVIER, 2017, 3750-3755. M. Zarghami, S. H. Hosseinnia**, Mehrdad Babazadeh.**

5	**"Flexible, Multi-Regional database usage of a new Computer-aided Relay Coordinator";** International Journal of Applied Mathematics, Electronics, and Computers (IJAMEC), 2016, 4(2), 39-44 **Mehrdad Babazadeh,** Vahid Farrokhi.
4	**"Requirements of a New Substation based Protective Relay Coordination";** International Journal of Applied Mathematics, Electronics, and Computers (IJAMEC), 2016, 4(1), 17-23. **Mehrdad Babazadeh,** Vahid Farrokhi, Mojtaba P. Eskandari.
3	**"Fault Diagnosis while Monitoring Environmental Conditions by a Wireless Sensor Network";** IFAC Proceedings Volumes 42 (13), ELSEVIER, 2009, ISSN: 1998-0140, Issue 2, Volume 2: P272-277. **Mehrdad Babazadeh**, Walter. Lang.
2	**"A Heuristic Method in Monitoring Environmental Parameters using a Floating Input Approach in Wireless Sensor Networks";** International Journal of mathematical models and methods in applied sciences (NAUN), Issue 2, Volume 2, 2008: P303-311. **Mehrdad Babazadeh**, Reiner Jedermann, Walter. Lang.
1	**"Selective Predictors of Environmental Parameters in Wireless Sensor Networks";** International Journal of Mathematical Models and Methods in Applied Sciences, 2008. ISSN: 1998-0140, Issue 3, Volume 2: P355-363. **Mehrdad Babazadeh,** Kreowski H.-J, Walter Lang**.**

- *Conference papers:*

21	**"Periodic Behavior of Telomerase Activity in Relation to Telomere Length in Some Human Cancers";** 4th International Student Biotechnology Congress, Feb 2019, Tehran/Iran. Mahdi Shakeri, **Mehrdad Babazadeh**, Raheleh Shakeri.
20	**"Highly-Distributed Sensor Processing using IoT for Critical Infrastructure Monitoring";** APSIPA ASC 2017, Malaysia. **Mehrdad Babazadeh**, Sokratis Kartakis, J.A. McCann.
19	**"Harmonics evaluation of 20 kV Syahpoush grid including wind site and harmonics control by parallel active filter";** 4th Iran Wind Energy Conference (IWEC 2016), July 20-21, Tehran, Iran. **(Written in Persian).** Saeed Nouri, **Mehrdad Babazadeh**, Kazem Mazlumi.
18	**"Performance Enhancement of Spark Ignition Engines by Using Fractional Order Controller".** ECC 2016, June 29 - July 1, Aalborg University, Aalborg, Denmark. Mahdi Zarghami, **Mehrdad Babazadeh**, S.H. Hosseinnia.

17	**"High-altitude wind speed Modeling and estimation";** 3rd National and First International Conference on applied research on Electrical, Mechanical, and Mechatronics Engineering, 17 _Feb. 2016, Malek Ashtar Technical University, Tehran-Iran. **(Written in Persian).** Mohammad Eftekhari, **Mehrdad Babazadeh**.
16	**"Wind speed estimation by using ANN and ANFIS";** International Conference on Energy technology and management, Scientific Energy Association, 2015, Tehran, Iran. **(Written in Persian).** Mohammad Eftekhari, **Mehrdad Babazadeh**.
15	**"A new method of wind speed estimation at high altitudes";** The 2nd national conference on renewable and clean energy, Uni. Mofatteh, Hamedan, Iran. **(Written in Persian).** Mohammad Eftekhari, **Mehrdad Babazadeh**.
14	**"Dynamic Ramp-Rate Limiter to enhance wind power plant performance";** ICAT'15, August 2015 Turkey. **Mehrdad Babazadeh**, Nasim Moein.
13	**"An Effective Technique of Simultaneous Fuel Consumption and Torque Error Reductions in Spark Ignition Engines";** ECC 2015, July 2015, Austria. Mahdi Zarghami, **Mehrdad Babazadeh**.
12	**"A new practical ARC-Shaped fractional order hold";** MED2015, Spain. **Mehrdad Babazadeh**, Jorge Martinez, Walter. Lang.
11	**"Control of Large Scale Wind Power Plants";** IEEE PES, 2012, US. Jorge Martinez, **Mehrdad Babazadeh**.
10	**"Energy saving by using floating input approach in a wireless sensor network";** 9th IEEE International Symposium on Signal Processing and Information Technology, Dec 14, 2009 - Dec 17, 2009, Ajman, United Arab Emirates. **Mehrdad Babazadeh**, Lal Ishwar, Walter. Lang.
9	**"Combinational Fault Diagnosis in a Monitored Environment by a Wireless Sensor Network";** 17th IEEE Mediterranean Conference on Control and Automation (Med09), June 24-26, 2009, Makedonia Palace, Thessaloniki, Greece. **Mehrdad Babazadeh**, Walter. Lang.

8	**"Comparative study of the best estimators in a New Modeling Technique Using Wireless Sensor Networks";** 8th WSEAS Int. Conf. on Simulation, Modeling, and Optimisation (SMO '08), September 23-25, 2008, Santander, Cantabria, Spain. **Mehrdad Babazadeh**, Reiner Jedermann, Walter. Lang.
7	**"Empirical Issues of a new Environmental Parameters Modeling Technique Using Wireless Sensor Networks";** The 12th international conference of WSEAS 2008, 22-24 July, Crete, Greece. **Mehrdad Babazadeh**, Reiner Jedermann, Walter. Lang.
6	**"A New Approach for Modeling Environmental Conditions using Sensor Networks";** 5th International Conference on Informatics in Control, Automation and Robotics (ICINCO 2008), 11-15 May 2008, Portugal. **Mehrdad Babazadeh**, Walter. Lang.
5	**"Overcurrent & Earth fault Mechanization Program (OE_MP)";** Power System Conf, 2004, Tehran/Iran. **(Written in Persian).** **Mehrdad Babazadeh**.
4	**"Assessment the effect of some hidden criterion on current protection relays";** Power System Conf, 2004, Tehran/Iran. **(Written in Persian).** **Mehrdad Babazadeh.**
3	**"A Mechanization program for distance relays";** Electric Protection Seminar, P12-18, 2002, Tehran/ Iran **(Written in Persian).** **Mehrdad Babazadeh**.
2	**"Design and implementation of robust adaptive speed control of 3 Phase AC motor by 12-pulse current source inverter by minimal control synthesis method (MCS)";** Iran Electrical Engineering Conf. 206-213. 2000, Isphahan. **(Written in Persian).** **Mehrdad Babazadeh**, Shahrokh Farhangi.
1	**"A Practical method for harmonic distortion reduction in power systems";** Electrical Protection Seminar, P1-8, 2000, Tehran, Iran. **(Written in Persian).** **Mehrdad Babazadeh**.