

NARAN M. PINDORIYA

Assistant Professor, Electrical Engineering

Indian Institute of Technology Gandhinagar, INDIA

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EDUCATION

- Ph.D., Electrical Engineering, Indian Institute of Technology Kanpur.
- M.E., Electrical Engineering, M.S. University of Baroda, Gujarat.
- B.E., Electrical Engineering, Gujarat University, Gujarat.

RESEARCH INTERESTS

- Restructured Power Systems – Operation and Management
- Smart Distribution Grid and Microgrids
- Grid Integration of Decentralized Energy Resources and Energy Management
- Load Demand and Electricity Price Forecasting

PROFESSIONAL AND RESEARCH EXPERIENCE

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| Assistant Professor Department of Electrical Engineering Indian Institute of Technology Gandhinagar, India. | Dec. 2010 – Till date |
| Research Fellow Department of Electrical and Computer Engineering National University of Singapore, Singapore. | Jan. 2010 – Nov. 2010 |
| Sr. Project Engineer Department of Electrical Engineering Indian Institute of Technology Kanpur, India. | Oct. 2009 – Dec. 2009 |
| Ph.D. Candidate & Teaching Assistant Department of Electrical Engineering Indian Institute of Technology Kanpur, India. | Jan. 2006 – Sept. 2009 |
| Lecturer Department of Electrical Engineering Charotar Institute of Technology-Changa, Gujarat University, India. | May 2003 - Dec. 2005 |

AWARDS

- Post-doctoral research fellowship in the Department of Electrical and Computer Engineering at National University of Singapore (NUS), January-November, 2010.
- Two cash awards for journal publication, awarded by Indian Institute of Technology Kanpur, in the years 2008 and 2010.
- Financial support by DST under the scheme of international travel support to present a research paper overseas, in the year of 2009.

- Best paper award in Student Paper Contest and Technical Symposium (SPCTS-2007), DAIICT, Gandhinagar, Gujarat.
- Graduate fellowship from January 2006 to September 2009, for conducting research towards PhD degree in Electrical Engineering in the Department of Electrical Engineering, Indian Institute of Technology Kanpur, India.
- Graduate Scholarship from July 2001 to April 2003, for doing Master's Degree in Electrical Engineering in the Department of Electrical Engineering, Faculty of Technology and Engineering, M. S. University of Baroda, Gujarat, India.

SPONSORED PROJECTS

- **Research Projects**

1. [PI]“Short-term generation scheduling in power systems under uncertainty/intermittent characteristics of renewable energy sources (RES) and demands” sponsored by Department of Science and Technology, New Delhi. (Ongoing)
2. [PI] “Design and development of Campus Energy Monitoring and Management System – a case study at IITGN campus” Sponsored by IITGN. (Ongoing)
3. Active coordinator in setting up two solar PV roof-top projects (each of 10 kWp) at IIT Gandhinagar in the year 2012. These PV systems are already operational and being used for advancing research and training the students in the field of solar photovoltaic and power engineering.
4. [Co-PI]“Technological value addition to the initial design of a low cost wind mill for pumping brine and for electricity production in rural areas” sponsored by GRiDS@IITGN–NIF, DST. (Completed)

- **Consulting Project (Completed)**

“Smart Grid pilot project – UGVCL” association with Uttar Gujarat Vij Company Ltd. (UGVCL), a one of the power distribution companies in Gujarat, India.

As part of the Phase-I (completed in 2012) of UGVCL Smart Grid pilot project, I significantly contributed in conceptualizing the Smart Grid for UGVCL and in developing white papers for UGVCL on different technologies associated with the Smart Grid.

I am now a member of expert committee to monitor the progress, evaluate the technical aspects involved in PoC and suggest implementation strategies for this project.

PUBLICATIONS

Book Chapter

1. Rajasekhar Batchu, Kalpesh Joshi, and **Naran M. Pindoriya**, Book chapter on “Integration of Distributed Renewable Energy Generation with Customer-end Energy Management System for Effective Smart Distribution Grid Operation” in

edited book titled “The Water-Food-Energy Nexus: Processes, Technologies and Challenges”, Taylor & Francis (Submitted).

2. Rajasekhar Batchu and **Naran M. Pindoriya**, Book chapter on “Residential Demand Response Algorithms: State-of-the-Art, Key Issues and Challenges”, in book titled, *Wireless and Satellite Systems, Lecture Notes of the Institute for Computer Sciences, Social Informatics and Telecommunications Engineering*, Vol. 154, Springer, 2015.
3. **Naran M. Pindoriya**, Dipankar Dasgupta, Dipti Srinivasan, Marco Carvalho, “*Infrastructure Security for Smart Electric Grid: A Survey*”, A book chapter in *Optimization and Security Challenges in Smart Power Grid*, Springer, 2013.

Journals/Magazines

1. **Naran M. Pindoriya**, Panida Jirutitijaroen, Dipti Srinivasan, and Chanan Singh, “Composite reliability evaluation using MCS and least squares support vector classifier”, *IEEE Trans. Power Systems*, vol. 26, no. 4, pp. 2483-2490, Nov. 2011.
2. **N.M. Pindoriya**, S.N. Singh, and S.K. Singh, “Application of adaptive wavelet neural network to forecast operating reserve requirements in forward ancillary services market,” *Applied Soft Computing*, vol. 11, no. 2, pp. 1811-1819, March 2011.
3. **N.M. Pindoriya**, S.N. Singh, and S.K. Singh, “Multi-objective mean-variance-skewness model for generation portfolio allocation in electricity markets,” *Electrical Power Systems Research*, vol. 80, no. 10, pp. 1314-1321, Oct. 2010.
4. **N.M. Pindoriya**, S.N. Singh, and S.K. Singh, “Forecasting of short-term electric load using application of wavelet transforms with feed-forward neural network,” *International Journal of Emerging Electric Power Systems*, vol. 11, no. 1, 2010.
5. **N.M. Pindoriya**, S.N. Singh, and S.K. Singh, “Short-term load forecasting in electricity markets,” *Direction, IIT Kanpur*, vol. 9, no. 1, pp. 141-147, Dec. 2008.
6. **N.M. Pindoriya**, S.N. Singh, and S.K. Singh, “An adaptive wavelet neural network-based energy price forecasting in electricity markets,” *IEEE Trans. Power Systems*, vol. 23, no. 3, pp.1423-1432, Aug. 2008.
7. **N. Pindoriya** and S.K. Shah, “Study of image classification accuracy of supervised neural network with traditional statistical methods of multi-temporal remotely sensed data,” *IE (India) Journal - Electronics and Telecommunications*, vol. 86, pp. 54-60, Jan. 2006.

Conferences

1. Rajasekhar Batchu and **Naran Pindoriya**, “Multi-Stage Scheduling for a Smart Home with Solar PV and Battery Energy Storage – A Case Study”, Accepted by *IEEE Innovative Smart Grid Technologies (ISGT) Asia 2015*, Bangkok, 4-6 Nov. 2015.

2. Rajasekhar Batchu and **Naran Pindoriya**, "Decentralized Energy Management for a Group of Heterogenous Residential Customers", Accepted by *IEEE Innovative Smart Grid Technologies (ISGT) Asia 2015*, Bangkok, 4-6 Nov. 2015.
3. Kalpesh Joshi and **N. M. Pindoriya**, "Day-Ahead Dispatch of Battery Energy Storage System for Peak Load Shaving and Load Leveling in Low Voltage Unbalance Distribution Networks", *IEEE PES General Meeting 2015*, USA, 26-30 July, 2015.
4. Bharat Singh Rajpurohit and Naran M Pindoriya, "Embracing microgrids: applications for rural and urban India", *National Conference on Indian energy sector-Synergy with Energy*, AMA, Ahmedabad, May 2015.
5. Batchu Rajasekhar and **N. M. Pindoriya**, "Optimal Energy Scheduling for a Smart Home Integrated with Solar PV and Battery Energy Storage", Int. Conf. & Exhibition on Smart Grids and Smart Cities, Indian Smart Grid Week (ISGW 2015), 3-5th March 2015, Bangaluru, India.
6. Rohith Varier and **N. M. Pindoriya**, "A novel active anti-islanding protection scheme for grid-interactive roof-top solar PV system", in *the 18th National Power Systems Conference (NPSC-2014)*, IIT Guwahati, India, Dec. 18-20, 2014.
7. Kalpesh Joshi and **N. M. Pindoriya**, "Reactive resource reallocation in DG integrated secondary distribution networks with time-series distribution power flow", in *IEEE International Conference on Power Electronics, Drives and Energy Systems (IEEE PEDES 2014)*, IIT Bombay, Mumbai, Dec. 16-19, 2014.
8. Rahul Anand Kaushik and **N.M. Pindoriya**, "Power flow control of hybrid AC-DC microgrid using master-slave technique", in *2014 IEEE Conference on Energy Conversion (CENCON 2014)*, Johor Bahru, Malaysia, Oct. 13-14, 2014.
9. Gourav Kumar and **N.M. Pindoriya**, "Outage management system for power distribution network", in *the International Conference on Smart Electric Grid 2014*, KL University, India, Sep. 19-22, 2014.
10. Rahul Anand Kaushik and **N.M. Pindoriya**, "A Hybrid AC-DC Microgrid: Opportunities & Key Issues in Implementation", *IEEE international conference Green Computing, Communication and Electrical Engineering (ICGCCEE'14)*, India, 6-8 March, 2014.
11. Kalpesh Joshi and **N.M. Pindoriya**, "Risk Assessment of Unintentional Islanding in a Spot Network with Roof-top Photovoltaic System – A Case Study in India ", *Innovative Smart Grid Technologies - Asia 2013 (IEEE PES-ISGT Asia 2013)*, Bangalore, India, November 10-13, 2013.
12. Kalpesh Joshi and **N.M. Pindoriya**, "Impact Investigation of Rooftop Solar PV System: A Case Study in India," *2012 3rd IEEE PES Innovative Smart Grid Technologies Europe (ISGT Europe)*, Berlin, October 14-17, 2012, pp. 1-8.
13. **N. M. Pindoriya** and N. Gurrupu, "Emerging Trends in Electricity Market in India – A Review," in *Proc. of the 2nd International Conference on Current Trends in*

Technology, NUICONE 2011, Institute of Technology, Nirma University, Ahmedabad, December 8-10, 2011, pp. 1-7.

14. Bharat Singh and **N.M. Pindoriya**, "Grid Integration of Large Scale Wind Power," in *Proc. of 7th National Conf. on Indian Energy Sector*, Ahmedabad, November 18-19, 2011.
15. Anupam Trivedi, **N. M. Pindoriya**, Dipti Srinivasan, and Deepak Sharma, "Multi-objective Evolutionary Algorithm for Day-Ahead Thermal Generation Scheduling," in *Proc. of the IEEE Congress on Evolutionary Computation*, New Orleans, USA, June 5-8, 2011, pp. 2170-2177.
16. Le Thanh Xuan Yen, Deepak Sharma, Dipti Srinivasan, and **N. M. Pindoriya**, "A Modified Hybrid Particle Swarm Optimization Approach for Unit Commitment," in *Proc. of the IEEE Congress on Evolutionary Computation*, New Orleans, USA, June 5-8, 2011, pp. 1738-1745.
17. Anupam Trivedi, **N. M. Pindoriya** and Dipti Srinivasan, "Modified NSGA-II for day-ahead multiobjective thermal generation scheduling," in *Proc. of 9th International Power and Energy Conference (IPEC2010)*, Singapore, October 27-29, 2010, pp. 752-757.
18. **N.M. Pindoriya**, S.N. Singh, and K.Y. Lee, "A comprehensive survey on multi-objective evolutionary optimization in power system applications," in *Proc. of 2010 IEEE PES General Meeting*, Minneapolis, Minnesota, USA, July 25-29, 2010, pp. 1-8.
19. **N.M. Pindoriya**, S.N. Singh, and S.K. Singh, "One-step-ahead hourly load forecasting using artificial neural network," in *Proc. of the 3rd International Conference on Power Systems (ICPS-09)*, IIT Kharagpur, India, Dec. 27-29, 2009, pp.1-6.
20. **N.M. Pindoriya**, S.N. Singh, and S.K. Singh, "Optimal generation portfolio allocation in competitive electricity market," in *Proc. of the 2009INDICON*, DA-IICT, Gandhinagar, Gujarat, India, Dec. 18-20, 2009, pp. 1-4.
21. **N.M. Pindoriya**, S.N. Singh, and J. Østergaard, "Day-ahead self-scheduling for thermal generator in competitive electricity market using hybrid PSO," in *Proc. of the 15th International Conference on Intelligent System Applications to Power Systems (ISAP 2009)*, Brazil, Nov. 8-12, 2009, pp. 1-6.
22. **N.M. Pindoriya** and S.N. Singh, "MOPSO based day-ahead optimal self-scheduling of generator under electricity price forecast uncertainty," in *Proc. of the 2009 IEEE PES General Meeting*, July 26-30, 2009, Calgary, AB, Canada, pp. 1-8.
23. **N.M. Pindoriya**, S.N. Singh, and S.K. Singh, "Forecasting the day-ahead spinning reserve requirements in competitive electricity market," in *Proc. of the 2008 IEEE PES General Meeting*, July 20-24, 2008, Pittsburg, PA, USA, pp. 1-8.
24. **N.M. Pindoriya**, S.N. Singh, and S.K. Singh, "Energy price forecasting in electricity markets: An overview and key issues," in *Proc. of the 2nd International Conference on Power Systems (ICPS-07)*, CPRI, Bangalore, India, Dec. 12-14, 2007.

25. **N.M. Pindoriya**, S.N. Singh, and S.K. Singh, "Short-term zonal load forecasting in PJM electricity market," *Student Paper Contest and Technical Symposium (SPCTS-2007)*, DAIICT, Gandhinagar, Gujarat, India, Sep. 28-30, 2007 (awarded first prize for the best paper).

RESEARCH GUIDANCE

- **PhDs registered: (Ongoing: 04)**

1. Kalpesh Joshi, "Development of optimization platform for scheduling generation from renewable energy resources", December 2011 onwards.
2. Batchu Rajasekhar, "Demand response algorithms for effective energy management at customer end" August 2013 onwards.
3. Rishabh Abhinav, "Dynamic performance analysis of wind energy penetration in to grid", June 2015 onwards.
4. Bala Sai Kiran Patnam, "Smart Building energy management system", Jan 2016 onwards.

- **M.Tech Dissertations supervised (Ongoing: 02, completed: 06)**

1. Rakesh G. "Design, Operation and Robust Control of Bi-directional Converter for AC-DC Microgrid Application, 2015-16
2. Puchalapalli Sambasivaiah "Harmonics assessment and comparative analysis of control strategies for Shunt Active Filter for harmonic suppression, 2015-16
3. Arun Nair, "Demand Response Algorithm Incorporating Electricity Market Prices for Residential Energy Management", 2014 (Graduated)
4. Rohith Varier, "A Novel Active Anti-Islanding Protection Scheme for Grid-Interactive Roof-Top Solar PV Systems", 2014 (Graduated)
5. Sreejith R., "Finite Control Set MPC based Distribution Static Synchronous Compensator (DSTATCOM) for Load Compensation", 2014 (Graduated)
6. Rahul Anand Kaushik, "Power Flow Management in Hybrid AC-DC Microgrid using Master-Slave Control Technique", 2014 (Graduated)
7. Gaurav Kumar, "Outage Management System for Power Distribution System", 2014 (Graduated)
8. Sherry Jain, "Least Distance Predictor Model for Short Term Load Forecasting", 2014 (Graduated)

COURSES TOUGHT

- Power Systems (UG level)
- Introduction to Electrical Engineering (UG level)
- Restructured Power Systems: Operation and Management (PG level)
- High Voltage DC and Flexible AC Transmission Systems (PG level)
- Solar PV: Basics, Technology and Applications (PG level)

PROFESSIONAL ACTIVITIES

- Member of the IEEE (S'07, M'10, SM'15)
- Reviewer of the IEEE Transactions on Power Systems
- Reviewer of the IEEE Transactions on Industrial Electronics
- Reviewer of the International Journal of Forecasting
- Life member of the Indian Society for Technical Education (ISTE)
- Associate member, Indian Smart Grid Forum (ISGF), India, (IIT Gandhinagar)

PROFESSIONAL PRACTICE

- Member of Academic council of Institute of Infrastructure, Technology, Research and Management (IITRAM) since June 2013. Active involvement in setting up Introduction to electrical engineering lab at IITRAM.
- Member of examiner to evaluate the M.S. thesis entitled "Control Algorithms for DVR to Mitigate Voltage Sags/Swells" submitted by K. Sridhar, Department of Electrical Engineering at IIT Madras.
- External examiner for eight MTech research students at Department of electrical engineering at Nirma University, Ahmedabad.
- External examiner for PhD thesis evaluations (02) – Department of Electrical Engineering, Faculty of Technology and Engineering, MS University Baroda.

OUTREACH ACTIVITIES

- Member, Organizing Committee of 3rd International Workshop on Software Engineering Challenges for the Smart Grid, June 1st, 2014, Hyderabad, India
- Workshop coordinator, IITGN-Syracuse University IAC joint workshop on Energy Efficiency at IIT Gandhinagar, 10-15th March, 2014.