

DR BIKASH CHANDRA PAL

B.Eng(Hons), M.Eng, Ph.D, DIC, FIEEEE(USA), FIET(UK)

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Overview

Bikash Pal is Professor of Power Systems at Imperial College London. He is research active in electrical power system stability, control and computation. His research is sponsored by ABB, GE, National Grid, and EPSRC UK. He leads a six-university UK China research consortium on Sustainable Energy Supply. Between 2013-2017, he led an eight-university UK-India research consortium on Smart Grid and Storage and a six-university UK-China research consortium in Smart Grid and Control. His research group has received 2016 President Award for Outstanding Research. Power network operators and transmission equipment manufacturers, United Nations (Clean Development Mechanism) have consulted him for solving technical problems in power transmission and renewable energy. He has offered training courses to practising engineers in power industry in power system stability, control and protections in several countries (Qatar, India, Chile, Malaysia) He has graduated 23 PhDs and published about 105 IEEE Transactions papers and co-authored four books. He is Vice President of Publications, IEEE Power and Energy Society. He is Series Editor of Elsevier series on Sustainable Energies and Fellow of IEEE. He was Editor-in-Chief of IEEE Transactions on Sustainable Energy (2012-2017) and IET Generation, Transmission and Distribution (2005-2012). He was Otto Monstead Guest Professor at Denmark Technical University (DTU) in 2019, was Mercator Professor sponsored by German Research Foundation (DFG) at University of Duisburg-Essen in 2011. He holds a Visiting Professorship at Tsinghua University, China.

Education

- **PhD and DIC** in Electrical and Electronic Engineering at Imperial College of Science, Technology and Medicine, University of London, 1999, Thesis: *“Robust Damping Control of Inter-area Oscillations in Power Systems with Superconducting Magnetic Energy Storage Devices”*.
- **M.Eng**, Electrical Engineering, Indian Institute of Science, India, 1992.
- **B.Eng**, Electrical Engineering at Jadavpur University, India, 1990.

Employment

- *Professor of Power Systems*, Electrical and Electronic Engineering Dept, Imperial College London, UK, 08/2013 -present.
- *Reader*, Electrical and Electronic Engineering Dept, Imperial College London, UK, 2007-2013.
- *Senior Lecturer*, Electrical and Electronic Engineering Dept, Imperial College London, UK, 2005-2007.
- *Lecturer*, Electrical and Electronic Engineering Dept, Imperial College London, 2001-2005.
- *Assistant Professor*, Electrical Engineering Dept, Indian Institute of Technology Kanpur, 1999-2001.
- *Lecturer*, Electrical Engineering Dept, Jadavpur University, India, 1993-1996.
- *Research and Design Engineer*, Tata Consulting Engineers, India, 1991-1993.

Honours

- Fellow, Royal Academy of Engineering, UK, 2023
- Otto Monstead Professor : Otto Monstead Foundation, 2019.
- Fellow of the IEEE for contribution to power system stability and control, 2013.
- Mercator International Professor: German Research Foundation, 2011.
- IEEE Power and Energy Society Distinguished Lecturer (DL), 2008-.

Awards

- IEEE PES Prize Paper Award 2018: Emilio Barocio, Bikash C. Pal, Nina F. Thornhill and Arturo Roman Messina : "A Dynamic Mode Decomposition Framework for Global Power System Oscillation Analysis", IEEE Transactions on Power Systems, Vol. 30, No. 6, pp. 2902-2912, Nov 2015
- IEEE PES Technical Committee Working Group Recognition Award for Benchmark Systems for Stability Controls Task Force, July 2016.
- President's outstanding research team award at Imperial College London 2016. This award celebrates the achievement of outstanding research teams at Imperial, recognising, a team 's international standing and their beneficial contribution to Imperial.
- Editor-in-Chief, IEEE Transactions on Sustainable Energy, 2012-2017.
- Series Editor of Elsevier monograph series on Sustainable Power and Energy Systems, 2014-present.
- Editor-in-Chief, IET Generation, Transmission and Distribution, 2005-2012.
- IET Renewable Power Generation Journal Annual Premium Paper Award, 2008.
- IEEE PES Working Group Recognition Award 2008 for the IEEE Special Publication 07TP190 Black-out Experiences and Lessons, Best Practices for System Dynamic Performance, and the Role of New Technologies.
- Visiting Professor, Tsinghua University, China, 2012-present
- Royal Society visiting fellowship, 2004.
- Young Teacher Award, All India Council for Technical Education (AICTE), 2000.
- Eryl Cadwallader Davies prize for the best PhD thesis in 1999 from Imperial College London.
- Commonwealth PhD Research Award, UK, 1996.

Research

Key research contributions

1. He pioneered *linear matrix inequality optimisation framework for robust control of power system inter-area oscillations*. Unlike generalised H_∞ robust control, this framework solved the damping control optimisation problem realistically satisfying the control requirement in power system. The outcome of this research has attracted ABB Corporate Research to set up strategic research collaboration with his research group in power transmission control since 2001 through series of fully funded research projects. A host of algorithms was transferred to ABB power business unit through a training workshop.

2. He and his students first proposed a *unified Smith predictor based control solution to eliminate the impact of remote feedback signal transmission delay in power system oscillations damping*.
3. He and his student developed a *generalised dynamic modelling framework for synchronous and asynchronous power generation in interconnected electric energy network for small signal stability analysis*. One research paper published in 2008 received the best technical journal paper of the year award from the IET Renewable Power Generation. This research in wind energy dynamic modelling have benefited industry (Alstom Grid, now GE Grid solutions UK) in their North Sea wind farm interconnection technical study and activities through several advanced technical consulting grants through college.
4. He and his research associate developed a *nonlinear signal processing algorithm to characterise the mechanism of power blackouts*. Besides power engineering research community, researchers from structural engineering, biomedical signal processing, speech and acoustics disciplines have cited this research.
5. He and his student introduced a *statistical method of sensor placement in power distribution network for state estimation*. This technique established the fact that only 15 to 20% of total power distribution network measurements are adequate to estimate the states of the entire system with 95% accuracy. The implication is in huge cost reduction in investment in sensor placement and associated data communication infrastructure. The follow on activity has not only cemented longer term collaborative partnership with UK power companies such as UKPN, Scottish and Southern (SSE), it also resulted in DNO Guide to Future Smart Management of Distribution Networks. Some of the earlier findings on power losses estimation is being applied to accurately estimate the loss in part of SSE distribution network model in Hampshire County.
6. He has developed a benchmark model for power system stability and control design upon invitation from the Chair of the IEEE Power and Energy Society (PES) sponsored Task Force on benchmark power system model.

Research grants

Over the past 15 years, the total value of the grants raised as PI is about £9M with his share of £5M. As Co-I, his share is £2.3 M.

35. PI: *Cyber Resilient Micro Grid: European Commission* : H2020-MSCA-IF-2020 EESC-P89866-101026657, 225k, 2021-2023
34. Co-I: *Renewable Energy EMPOWERing European and InDian communities (RE-EMPOWERED)*, H2020-LC-SC3-2020-NZE-RES-CC-IA: EESC-P89162- 101018420, 562k, 2021-2024.
33. Co-I: *InnoCyPES* European Commission: H2020-MSCA-ITN-2020 EESC-P85490- 956433, 606k, 2021-2024.
32. PI: *MIDER: Monolithic integration of Renewable Energy Resources* : European Commission: H2020-MSCA-IF-2020 Marie Curie programme: 212k 2020-2022.
31. PI: *Resilient Operation of Sustainable Energy Systems (ROSES)* EPSRC-NSFC Programme on Sustainable Energy Supply £775k. Prof. Pal leads the UK side of this six-university (Imperial, Southampton and Warwick, Hohai, NCEPU and Tsinghua) consortium project.
30. Co-I: *WinGrid* European Commission: H2020-MSCA-ITN-2019 EESC-P79159-861398 606k 2019-2023
29. PI: *Estimation in PV dominated power network for stability and control* ,EESC P78479, EPSRC, UK, £100k, 2019-2020.

28. PI: *A Novel Hybrid Microgrid Control Framework Including Multi-Mode Large-scale EVs Integration* TGOOD, Hong Kong £500k, 2018-2022.
27. PI: *PV Control and Integration (PVCI)*: European Commission: H2020-MSCA-IF-2016 Marie Curie programme: 183k 2017-2019.
26. Co-I: *Joint UK-India Clean Energy Centre (JUICE)*: EP/P003605/1: £1M, 2016-2020. Prof Pal leads Imperial on this multi-university programme.
25. PI: *State Estimation for Active Distribution Network*, Scottish and Southern Energy (SSE) UK, £25k, 2015-2016.
24. PI: *Stability and Control of Power Networks with Energy Storage (STABLE-NET)* UK-China Grid Scale Storage, EPSRC, UK,(EP/L014343/1) £1.0M, 2014-2016. Prof. Pal led this three-university (Imperial, Oxford and Strathclyde) consortium project.
23. PI: *Investigation of Sub-synchronous Interaction between Wind Turbine Generators and Series Capacitors*, National Grid, UK, £60k,2014-2015.
22. PI: *Model Simplification of Wind Farm for Grid Interaction Study*, ALSTOM UK, £100k, 2015-2017.
21. PI: *Reliable and Efficient System for Community Energy Solution- RESCUES*, UK-India Smart Grid programme, EPSRC, UK, EP/K03619X/1: £980k, 2014-2016. Prof. Pal led this three-university (Exeter, Imperial and Strathclyde) consortium project.
20. Co-I: *Advanced Communication and Control for the Prevention of Blackouts (ACCEPT)*, UK-India Smart Grid programme, EPSRC, UK,EP/K036173/1: £310k, 2014-2016.
19. Co-I: *PV2025 - Potential Costs and Benefits of Photovoltaics for UK-Infrastructure and Society*, EP-SRC, UK, EP/K02227X/1: £308k, 2013-2016.
18. PI: *Offshore HVDC grid development in the North Sea: a pre-study*, STATNET, Norway, £20k, 2012.
17. PI: *State Estimation for Active Distribution Network*, Scottish and Southern Energy (SSE) and EP-SRC, UK, £102k, 2011-2015.
16. PI: *Modeling and control of AC-DC System with Significant Generation from Wind*, National Grid, UK, £45k, 2010-2014.
15. PI: *Stability and Performance of Photovoltaics* EPSRC, UK,£571k, 2010-2013.
14. Co-I: *Using Real-time Measurements for Monitoring and Management of Power Transmission Dynamics for the Smart Grid*, European Commission, £353k, 2010-2014, as Co-I his share: £175k.
13. Co-I: *Power System Wide-area GPS Synchronized Monitoring with Phasor Measurements and Low-Frequency Oscillation Mitigation Analysis* European Commission 137k: 2010-2011: as Co-I his share: £68.5k.
12. Co-I: *Control for Energy and Sustainability*, EPSRC, UK, £5.8M : 2009-2014, as Co-I his share: £100k.
11. PI: *Smart and Flexible Control*, The Beit Trust,£33k, 2008-2011.
10. PI: *A Wide-Area System for Power Transmission Security Enhancement using a Process Systems Approach* EPSRC, UK, £272k, 2007-2010.
9. PI: *Risk Assessment of Distribution Systems for Operational Purposes*, £450k, as PI his share: £270k.

8. PI: *SUPERGEN FLEXNET* EPSRC, UK, £6.38M, 2007-2011: as Co-I his share: £330k.
7. PI: *Feasibility of Risk Assessment in EDF Network*, EDF Energy, UK, £48k, 2006-2006.
6. PI: *State Estimation in Distribution Network: Methodology and Implementation* EDF Energy UK, £400k, 2006-2009, as PI his share: £240k.
5. PI: *Measurement based FACTS control in power systems*, ABB Switzerland, \$300k, 2004-2006.
4. Co-I: *Future Network Technologies for Sustainable Energy Generation (Supergen)*, EPSRC UK, £520K, 2004-2006, as Co-I his share £200k.
3. PI: *Robust Damping of Oscillations in Large Power Grid Through FACTS Controllers Employing Global Signals*, EPSRC, UK, £123k, 2002-2005.
2. Co-I: *Single and Multiple UPFCs as Aids to the Improvement of Supergrid Dynamic and Transient Performance*, ABB USA, £104k, 2002-2005 : As PhD supervisor and grant service provider of the grant held by Green and Jaimoukha.
1. Co-I: *Single and Multiple UPFCs as Aids to the Improvement of Supergrid Dynamic and Transient Performance* EPSRC, UK, £238k, 2002-2004 : As PhD supervisor and grant service provider of the grant held by Green and Jaimoukha.

Research supervision

PhD students supervision in progress

9. Abdul-Jalil Alzadani
8. Ali Arjomandi
7. Mert Kesici
6. Sai Pavan Polisetty
5. Andreas Nikolou
4. Yanshu Niu
3. Jintao Wang
2. Malek AM Alduhaymi
1. LIU Zhaoru, (PhD 2nd Year)

PhD students graduated

(Total: 25; 19 sole supervision and 3 joint supervision)

25. Sowmya Nagam *Synchronization Stability Analysis and Control of Grid-connected Wind Farms*, 2020-2023, National Grid ESO
24. Yue Yu Yue Yu *Smart Electric Vehicle Charging Strategy in Direct Current Microgrid*, 2018-2022, TGOOD, China.
23. Nicolás Cifuentes *A New Approach to the Fault Location Problem: Using the Fault's Transient Intermediate Frequency Response*; 2017-2021, International Power System Consultants, London.

22. Jerome Nsengiyaremye *Protection of Multi-Inverter Based Microgrid Using Phase Angle Trajectory*; 2017-2020, MIT, Boston, USA
21. Firdous Ul-Nazir, *Stochastic Volt/VAr Control of Power Distribution Systems*; 2016-2019, Imperial College London.
20. Husni Ali Rois, *Model Order Reduction of Wind Farm*; 2015-2019, Universitas Gadjah Mada, Indonesia
19. Onyema Nduka, *Impact Assessment of Harmonics Emissions on Active Distribution Network Planning and Operation*; 2015-2018; Imperial College London.
18. Luching Zhang, *Optimal Scheduling in Sensor Networks*; 2013-2017, joint supervision with Dr Eric Kerrigan, CITI bank.
17. Georgios Anagnostou, *Dynamic State Estimation Under Stressed Conditions in Modern Power Networks*; 2012-2016, joint supervision with Prof Nigel Brandon of Earth Science Engineering, Imperial College London.
16. Ankur Majumdar, *Security in Power System State Estimation*; 2012-2016, Imperial College London.
15. Sara Nanchian, *State estimation for active distribution network*; 2011-2015, Imperial College London.
14. Abhinav Singh, *Decentralised Estimation and Control for Power Systems*; 2011-2014, Imperial College London.
13. Mohd Bin Ariff, *Adaptive Protection and Control for Wide-Area Blackout Prevention*; 2010-2014, Universiti Tun Hussein Onn Malaysia.
12. Stefanie Kuenzel, *Modelling and control of an AC-DC system with significant generation from wind*; 2010-2014, Royal Holloway, University of London.
11. Yashodhan Agalgaonkar, *Control and Operation of Power Distribution System for Optimal Accommodation of PV Generation*; 2010-2014, Imperial College London.
10. Linash Puthenpurayil Kunjumammed, *Analysis and Control of Power System with Wind Generation*; 2008-12, Imperial College London.
9. Dumisani Simfukwe, *Enhancement of Power System Loading Capacity Through Low Order Robust Control Design*; 2008-12, ALSTOM R&D.
8. Efthymios Manitsas, *State Estimation and Active Management in Power Distribution Networks*; joint supervision with Prof Strbac, 2006-11, Worley Parson, UK.
7. Jerry Thambirajah, *A wide area system for power transmission security enhancement using a process systems approach*; joint supervision with Prof Thornhill of Chem Engg., Credit Swiss, UK, 2008-11.
6. Ravindra Singh, *State estimation in power distribution network operation*; 2006-09, ABB Corporate Research, USA.
5. Françoise Mei, *Small-signal modeling and analysis of doubly-fed induction generators in wind power applications*; 2004-08, MSCI, London.
4. Fu Le, *Voltage stability monitoring and enhancement in electrical power systems using transformer tap changers*; 2004-07, National Grid, UK.
3. Krishna Kumar Anaparthi, *Measurement based identification and control of electromechanical oscillations in power systems*; 2003-06, GE Global Research Centre, Germany.

2. Rajat Majumder, *Design and laboratory implementation of robust FACTS controller for interconnected power systems*; 2003-05, University of Queensland, Australia.
1. Balarko Chaudhuri, *Robust control of inter-area oscillations in power systems using FACTS controllers*; 2002-05, Imperial College London.

Post-Doc supervision

- 1 Dr Yifei Guo, Resilient Operation in Sustainable Energy Systems (2020-present)
- 2 Dr Georgios Kampitsis , Modelling and control of wide bandgap power devices for power network stability improvement (2020-present)
3. Dr Firdous Ul-Nazir, Robust voltage and var control in power distribution networks (2020-present)
4. Dr Onyema S Nduka, Harmonics modelling and analysis in power distribution networks (2019-2020)
5. Dr Efstratios Batzelis, PV integration and control (2017-2019 MC Fellow , 2020-2025, RAEngg Fellow)
6. Dr Georgios Anagnostou, power system stability (2016-2019)
7. Dr Ankur Majumder, power system state estimation (2016-2017)
8. Dr Sara Nanchian, power system state estimation (2016-2017)
9. Dr Abhinav K Singh, power system dynamics, stability and control (2014-2017)
10. Dr Stefanie Kuenzel, Windfarm layout optimisation and control (2013-2016)
11. Dr Linash Puthenpurayil Kunjumuhammed, wind energy control (2012- 2019).
12. 10 other post docs for a combined total of 15 RA years between 2001-2014.

Academic Visitors

1. Dr Mats Larsson (3 months), Senior Principal Scientist, ABB Corporate Research, Switzerland, 2014
2. Dr Yan Zhang (3 months), Principal Scientist, ABB Corporate Research, Switzerland, 2014.
3. Dr Tatiana Mariano Lessa de Asiss (12 months), UFRJ, Rio de Janeiro, Brazil, 2015.
4. Prof. Antonio Padhila Feltrin (12 months), UNESP, Brazil, renewable energy, 2012
5. Prof. Odilon Tortelli (12 months), University of Parana, Brazil, control, 2012.
6. Prof. Elizete Lourencio (12 months), University of Parana, Brazil, state estimation, 2012.
7. Six other academic visitors spent their sabbaticals in his group between 2001-2011.
8. Mr Gustavo Dill (6 months), Federal University of Santa Catarina, Brazil, robust control, 2012
9. Mr. Antti Harzula (3 months), FINGRID, Finland, dynamic monitoring, 2012.
10. Dr Eduardo Caro (4 months), Universidad de Castilla, Spain, state estimation, 2010.
11. Prof. Emilio Barocio (3 months), University of Guadalajara, Mexico, dynamic monitoring, 2009.
12. Prof. Arturo R. Messina (1 month), CINVESTAV, Mexico, dynamic monitoring, 2007.
13. Prof. Chandan Chakraborty (1 month), IIT Kharagpur, renewable energy, 2004.

Collaborators

1. Prof Nina Thornhill, Imperial College: dynamic monitoring, 2005-2020.
2. Dr Nelson Martins, CEPEL, Brazil: power system control, 2009-2012.
4. Prof Chandan Chakraborty, IIT Kharagpur: photovoltaics, 2011-present.
5. Prof Erlich Istvan, University of Duisburg-Essen: AC-DC grid, 2011-2012.
6. Prof Miroslav Begovic, Georgia Tech, Texas A & M USA: voltage stability and protection, 2008-2009, 2018-2020.
7. Prof Arturo R. Messina, CINVESTAV, Mexico, dynamic monitoring 2007-2010.
8. Prof Rabih Jabr, American University of Beirut: power system computation and control, 2003-present

Teaching

He has developed and taught the following lecture courses:

1. Power Electronics and FACTS (M.Eng/MSc, 4th year) (50%; 2007-present)
2. Power System Control, Measurements and Protections (M.Eng/MSc, 4th year) (100%; 2007-present)
3. Electric Energy Systems (B.Eng, 3rd year) (50%; 2002-2006)
6. Environmental and Economic Issues in Power Systems (M.Eng, 4th year) (50%; 2002-2006)
5. Modeling and Control in Power Engineering (M.Eng/MSc, 4th year)(50%; 2002-2006)
4. Power System Dynamics and Stability (at IIT Kanpur)(M.Tech) (100%, 2000-2001)
5. Advanced Power System Stability (at IIT Kanpur)(M.Tech)(100%, 2000-2001)
6. Electrical Technology (at Jadavpur University)(B. Eng)(100%; 1993-1996)
7. Principle of Electrical Engineering (at Jadavpur University)(B.Eng) (100%; 1993-1996)

Departmental administration

Examinations, programme management

- *Director, MSc programme in Future Power Networks:* As founding director he developed the entire curriculum and now leads the programme (2014-2018).
- *Examination officer:* He led the department exam paper production process, 2004-2012.

Student scholarship, international education exchange

1. At Imperial he led an initiative to obtain scholarship for UG students from industry sponsored UK Power Academy. 46 scholarships were secured between 2007-2011. More than 50% scholars remained in UK power sector after graduation.
2. He led an initiative in setting up longer term collaboration with power companies and academic in Brazil leveraging Science Without Border programme of Brazilian Govt. So far 5 Brazilian researchers in power area have joined the group.

External professional activities

External examinations

- *MSc course*, Brunel University, 2012-2016.
- *BEng course*, University of West Indies, 2009-2010.
- *PhD examiners*, University of Warwick, Birmingham, Manchester, London, West Indies, Liege, NTNU, QUT, NTU, Aalborg , DTU, and IITs.

Member of peer review panels

- Chair, International Panel, Science Foundation Ireland (SFI), Partnership Programme, 2021.
- Member, International Advisory Committee, North China Electric Power University , 2019-
- Member, International Panel, Science Foundation Ireland (SFI), Partnership Programme, 2015.
- Programme Evaluator: Europe-China Clean Energy Centre (EC2), joint programme of Politecnico di Torino, Italy and Tsinghua University, China, 2012.
- National Council for Scientific Research, Lebanon, 2011.
- Texas A & M University, Distinguished Professorship Evaluation Panel, 2011.
- EPSRC, UK, 2006-present.
- Archimedes-III of the Govt of Greece, 2011.
- Thalys of the Govt of Greece, 2011.
- National Priority Research Programme, Qatar National Research Foundation, 2009.
- Research Proposal, King Fahd University of Petroleum and Minerals, 2009.

Editorial activities

- Senior Editorial Advisor (SEA) *Journal of Modern Power Systems and Clean Energy*, State Grid Corporation Electric Power Research Institute , China.
- Editor-in-Chief, *IEEE Transactions on Sustainable Energy*, 2012-2017. The journal received its first impact factor of 3.84 in June 2014 and the 2018 impact factor is 7.65.
- *Series Editor of Elsevier monograph series on Sustainable Power and Energy Systems*, 2014-2018.
- Editor-in-Chief, *IET Generation, Transmission and Distribution*, 2005-2012. Journal impact factor improved from 0.29 (2005) to 1.19 (2011)
- Associate Editor, *IEEE Transactions on Control Systems Technology*, 2014-present.
- Editor, *IEEE Transactions on Sustainable Energy*, 2009-2012.
- Associate Editor, *International Journal of Systems Science*, 2003-2009.
- Editorial Board, *International Journal of Electric Power Components and Systems*, 2003-2009.

Roles in IEEE Task Forces, Working Groups and Committees

- Member, IEEE PES Governing Board (2019-)
- Member, IEEE PES Executive Committee (2019-)
- Member, IEEE PES Finance Committee (2019-)
- Vice President, Publications, IEEE Power and Energy Society (2019-)
- Vice Chair, IEEE Power System Dynamic Performance Committee of the Power and Energy Society
- Chair: IEEE PES Working Group on Distribution System State Estimations: Practical Challenges, Limitations of Current Tools and Research Need, 2013-present.
- Member: IEEE Periodical Committee (PerCom) (2018-2019): Responsible for assessing new periodical proposals and working with committee Chair for making recommendation to TAB.
- Chair: Non-PES Conference Liaison (NPCL) Committee of the IEEE Special Publications and Outreach Programme, 2008-2012.
- Member representing the UK, International Task Force on Blackouts Investigation, Analysis and Mitigation, IEEE PES, 2006-2008.
- Member representing the UK, Task Force on Advanced Power System Security, C4 of CIGRE, 2004-2007.

Conference panel chairs

- Chair: Keynote Speech Session, 6th IEEE PES Asia-Pacific Power and Energy Engineering Conference, Hong Kong, 7-10 December, 2014.
- Panel Chair: Stability and Control in Smart Power Grid, 8th IFAC Symposium on Power Plant and Power Systems Control (PPS), Toulouse, France, September 2-5, 2012
- Panel Chair: Challenges in Distribution System State Estimation , IEEE PES General Meeting, San Diego, CA, USA, 22-26 July, 2012.

Industrially funded consulting

Besides winning the best annual journal paper award in 2009, the research in wind energy dynamic modelling have benefited industry (Alstom Grid, now GE Grid solutions UK) in their North Sea wind farm interconnection technical study. Tools were developed for the dynamic analysis and interaction study for National Grid.

- *Renewable Dispatch Down: Visibility and Forecasting tools, ESNB, Ireland, 2023*
- *Stability criteria and specifications of power electronics interfaces for power network operation, National Grid Electricity Transmission (NGET) (2020-2021)*
- *Technical methodology and tool development to support Clean Development Mechanism (CDM), United Nations Framework on Climate Change. Appointed as technical consultant to review and recommend revised methodology and tool for transmission constraint and losses calculation, United Nations, Bonn, Germany Aug-Oct 2017.*
- *Small scale energy storage (SSES), UK Power Networks, 2016-2017*

- *Windfarm dynamic equivalencing*, GE Grid Solutions UK Ltd, 2016-2019.
- *Technical investigation of sub-synchronous interaction between wind turbine generators and series capacitors*, National Grid, UK, 2014-2015.
- *Aggregated wind farm dynamic interconnection model and analysis involving Type-IV turbines*, ALSTOM UK, 2015-2016.
- *Aggregated wind farm dynamic interconnection model and analysis involving Type-III turbines*, ALSTOM UK, 2014-2015.
- *Investigation of synchronisation problem of offshore wind farm with the grid*, ALSTOM, UK, 2013-2014.
- *North Sea power grid vision for Norwegian power grid operator, STATNET, Norway*, 2012.

Invited lectures

Keynotes and plenary talks

- *Optimal Voltage Ride-Through of IBR-Dominated Power Systems*, keynote talk, ISGT Middle East Conference, March 13-15, 2023, Abudhabi, UAE.
- *Optimal Voltage Ride-Through of IBR-Dominated Power Systems*, Keynote talk, National Power System Conference, 16-18 December, 2022, New Delhi, India
- *Robust Volt Var Control in Power Distribution Systems, keynote talk* , *The 7th International Web Conference on Sustainable and Renewable Energy Engineering*, May 5-7, 2022, Madrid, Spain.
- *Dynamic Modeling for Analysis of Wind Farm and Grid Interaction*, keynote talk, International Conference on Power, Energy and Electrical Engineering , Oct 9-10, 2021, Beijing, China.
- *Robust Volt Var Control in Power Distribution Systems*, keynote talk , 11th International conference on power sciences and engineering , Oct 21-23, 2021, Istanbul, Turkey.
- *Robust Volt-Var Control in Power Distribution Systems*, keynote talk, Second International Conference on Smart Energy Technologies, Sept 8-10, 2021, Finland.
- *Volt-Var Control in Power Distribution Systems*, keynote talk, 12th IEEE PES Asia-Pacific Power and Energy Engineering Conference, Nanjing, China, Sept 2020.
- *Dynamic Modeling for Analysis of Wind Farm and Grid Interaction*, keynote talk, International Conference on Power, Energy and Electrical Engineering , Dec 19-21, 2018, London, UK.
- *Dynamic Modeling for Analysis of Wind Farm and Grid Interaction*, keynote talk, Second International Conference on Smart Energy Technologies, Sept 9-11, 2019, Porto, Portugal.
- *Dynamic Modeling for Analysis of Wind Farm and Grid Interaction*, keynote talk, 20th National Power System Conference, Dec 14-16, 2018, NIT Trichy, India.
- *Role of Control and Measurement in Future Power Networks*, plenary talk, IEEE International Conference on Control , Measurement and Instrumentation , Jan 2016, Kolkata, India.
- *Role of Robust Control in Smart Grid*, keynote, 12th SEPOPE Conf. CIGRE, May 2012, Rio de Janeiro, Brazil.

- *Control and computation in Smart Grid*, keynote, IEEE Conf. on Power, Control, Signal Processing and Computations (EPSCICON), Jan 2012, Kerala, India.
- *Role of Robust Control in Smart Grid*, keynote, IEEE Conf. on Power Electronics, Drives and Energy Systems, Dec 2010, New Delhi, India.
- *Computational Advances in Robust Power Transmission Control*, plenary, Intl Conf. on Advances in Computational Tools For Engineering Applications, July, 2009, Beirut, Lebanon.
- *Power System Stability: New Challenges and New Solutions*, keynote, IEEE PES Symposium, Nov 2006, Zurich, Switzerland.
- *Small Signal Modelling and Analysis of Variable Speed Wind Energy Conversion Systems*, keynote, IEEE PES Symposium on Modeling and Analysis of Large Electrical Machines, Aug 2005, Calcutta, India.

IEEE Distinguished Lectures

- *Robust Volt Var Control in Power Distribution Systems*, IEEE IAS/PES Chapter, Bombay, India 2022.
- *Robust Volt Var Control in Power Distribution Systems*, IEEE PES Chapter, Shanghai, China, 2022.
- *Robust Volt Var Control in Power Distribution Systems*, IEEE PES Chapter, Utah, USA, 2021.
- *Robust Volt Var Control in Power Distribution Systems*, IEEE PES Chapter, Malaysia, 2021.
- *Dynamic Modeling for Analysis of Wind Farm and Grid Interaction*, IEEE PES Chapter, Victoria, Australia, 2021.
- *Robust Volt Var Control in Power Distribution Systems*, IEEE PES Chapter, Utah, USA, 2021.
- *Robust Volt Var Control in Power Distribution Systems*, IEEE PES Chapter, Malaysia, 2021.
- *Dynamic Modeling for Analysis of Wind Farm and Grid Interaction*, IEEE PES Chapter, Victoria, Australia, 2021.
- *Robust Volt Var Control in Power Distribution Systems*, IEEE PES Chapter, South Australia, Australia, 2021.
- *Robust Volt Var Control in Power Distribution Systems*, IEEE PES Chapter, Idaho, USA, 2021.
- *Robust Volt Var Control in Power Distribution Systems*, IEEE PES Chapter, Saudi Arabia, 2020.
- *Dynamic Modeling for Analysis of Wind Farm and Grid Interaction*, IEEE PES Chapter Italy, 2020.
- *Dynamic Modeling for Analysis of Wind Farm and Grid Interaction*, IEEE PES Chapter Macedonia, 2020.
- *Dynamic Modeling for Analysis of Wind Farm and Grid Interaction*, IEEE PES Chapter Portugal, 2020.
- *Dynamic Modeling for Analysis of Wind Farm and Grid Interaction*, IEEE PES Chapter Netherlands, 2020.
- *Dynamic Modeling for Analysis of Wind Farm and Grid Interaction*, IEEE PES Chapter Turkey, 2020.
- *Dynamic Modeling for Analysis of Wind Farm and Grid Interaction*, IEEE PES Chapter Romania, 2020.

- *Dynamic Modeling for Analysis of Wind Farm and Grid Interaction*, IEEE Subsection Bhubaneswar, India, 2020.
- *Dynamic Modeling for Analysis of Wind Farm and Grid Interaction*, IEEE PES Chapter, Delhi, India, 2020.
- *Dynamic State Estimation and Control of Power Systems*, IEEE PES Chapter, Gujarat, India, 2020.
- *Dynamic State Estimation and Control of Power Systems*, IEEE PES Chapter, Kolkata, India 2020.
- *Dynamic State Estimation and Control of Power Systems*, IEEE PES Chapter, Singapore, 2020.
- *Dynamic State Estimation and Control of Power Systems*, IEEE PES Chapter, Denmark, 2020.
- *Dynamic State Estimation and Control of Power Systems*, IEEE PES Chapter, UKRI, UK, 2020.
- *Advances in Computations and Control in Power Systems*, IIT Madras, India, 2009.
- *Measurement Placement for Distribution System State Estimation* in Jadavpur University, Kolkata, 2009.
- *Computational Advances in Robust Power Transmission Control*, IIT Kharagpur, India, 2009.
- *Robust Power Transmission Control*, Power Grid Corporation of Bangladesh, Dhaka, 2009.
- *Advances in Computation and Control in Power Systems*, BUET, Dhaka, 2009.
- *Linear Matrix Inequality (LMI) approach to damping control design employing FACTS devices* POLITECNICO DI TORINO, Italy, 2009.
- *Linear Matrix Inequality (LMI) approach to damping control design employing FACTS devices*, CEPTEL, Brazil, 2008.
- *Robust Control of Power Systems*, University of Guadalajara, Mexico, 2008.

Invited industry courses/tutorials

- *Power System Stability and Control*, Blazeavenue, Dubai, December, 2018.
- *Power System Protections*, Tenaga Nasional Berhad (TNB), Malaysia, November, 2017.
- *Wind farm interaction with VSC*, GE Grid Solutions, stafford, UK, October, 2016.
- *Power System Dynamics, Stability and Control*, System Operators: CDEC-SIC and CDEC-SING, Santiago, Chile, September, 2016.
- *Sub-synchronous interactions between wind turbine generators and series compensation: A case study for GB model*, Warwick, UK, April, 2016.
- *Stability modeling and analysis of renewable energy sources*, 10 days long course under Global Initiative of Academic Networks, National Institute of Technology, Agartala, India. January 2016.
- *Stability and Control Problem in Interconnected AC Systems*, Abu Dhabi Water and Electric Authority (ADWEA), April, 2015.
- *Power System Protections*, Continuing Education Programme, Texas A & M , Qatar, 2014.
- *Power System Measurement, Control and Protection*, Continuing Education Programme, Texas A & M , Qatar, 2013.

- *Power System Stability*, Tata Consulting Engineers, Bangalore, 2011.
- *Overview of Power System Stability*, Worley Parsons Limited, London, 2011.
- *Subsynchronous Resonance in Power Systems*, Worley Parsons Limited, London, 2009.
- *Power Generation Control*, CESC Ltd, Kolkata, 2007.

Other invited lectures

- *Control and Computation for Future Power Networks*, Pontificia Universidad Catholica de Chile, Chile, September 2016.
- *Control and Computation for Future Power Networks*, Indian Institute of Technology, Delhi, May 2015.
- *Control and Computation for Future Power Networks*, MASDAR Institute, Abu Dhabi, UAE, April 2015.
- *Control and Computation for Future Power Networks*, University of Oxford, UK, June 2014.
- *Robust Control and Computation of 21st Century Electricity Grid*, Hong Kong Polytechnic University, Hong Kong, August 2013.
- *Role of Control and Computation in Smart Grid*, ETH, Zurich, 2012.
- *The Emerging Distribution Network: Operation and Control Issues*, Tsinghua University, China, 2012.
- *Robust Control and Computations in Power Systems*, Virginia Tech, USA, 2012.
- *State Estimation of Power Distribution Network*, GE Global Research Centre, Munich, Germany, 2012.
- *Low order robust control in electric power system: current trends and future challenges*, 2012 UKACC international control conference, 3-5 September, Cardiff, 2012.
- *Role of Robust Control and State Estimation in Future Electricity Networks*, University of Toronto, Canada, 2012.
- *Control and computation in power systems*, University of North Carolina Charlotte, USA, 2011.
- *State estimation for smart power distribution system*, EDF France, 2011.
- *State estimation for smart power distribution system*, Centenary lecture, Electrical Engineering, IISc Bangalore, 2011.
- *Role of Robust Control and State Estimation in Future Electricity Networks*, University of Liege, Belgium, 2011.
- Between 2001-2010, he has delivered eight other invited lectures at various universities abroad.

Media appearances

- *The Sunday Times UK*, on wind energy, 29th March, 2008.
- *BBC News 24* on wireless power transfer, 18th October, 2007.
- *The Independent, UK*, on electrical engineering education, 26th April, 2006.
- *New Scientist*, 2003, on power blackouts in USA (14th August 2003) and in Italy (28th Sept 2003).

Research publications

According to Google scholar, total citations: 17000, h-index: 64

Books

- Linash Kunjumammed, Stefanie Kuenzel and Bikash Pal ,*Simulation of Power System with Renewables*, Elsevier, ISBN9780128111871, 2019.
- Abhinav Kumar Singh and Bikash C. Pal, *Dynamic Estimation and Control of Power Systems*, Elsevier, ISBN 9780128140062, 2018.
- Xiao-Ping Zhang, Christian Rehtanz and Bikash Pal *Flexible AC Transmission Systems: Modeling and Control*, Springer, Berlin, ISBN: 3-540-30606-4, 2012.
- Bikash Pal and Balarko Chaudhuri *Robust Control in Power Systems*, Springer, New York, ISBN: 0-387-25949-X, 2005.

Patents

1. Power Transmission Networks, 10263425, April 16, 2019 Inventors: Colin Donald Murray Oates, Bikash Pal, Linash Puthenpurayil Kunjumammed, Assignee: GENERAL ELECTRIC TECHNOLOGY GMBH
2. Power System Control , EP2979343A1, Inventors: Nina Frances THORNHILL, Bikash PAL, Davide FABOZZI Current Assignee Ip2ipo Innovations Ltd

Pal, "Steady state and small signal dynamic behaviours of doubly fed asynchronous generators", *CIGRE Special Task Force Publication on Modeling and Dynamic Behavior of Wind Generation as it Relates to Power System Control and Dynamic Performance*, C4.601, no 328, pp A1-A18, August 2007.

Journals

Total journal publications - 150: IEEE Transactions - 124, IET/IEE journals - 21, other journals - 4, under review -4

151. Y. Niu, J. Nsengiyaremye and B. C. Pal , "Transient Monitoring Function-Based Distribution System Protection", *IEEE Transactions on Power Delivery*, under review
150. S. Nagam, M. Larsson and B. C. Pal " Dynamic Mode Decomposition for Stability Assessment of Wind Farms," *IEEE Transactions on Power Systems*, under review.
149. A. S. Mir, A. K. Singh, N Senroy and B. C. Pal "Impact of Backlash Nonlinearity on the Dynamics of Type-3 Turbine-based Windfarms," *IEEE Transactions on Power Systems* , available through early access.
148. B Pawar, E. I. Batzelis, S Chakrabarti, B. C. Pal ,B. Pawar, E. I. Batzelis, S. Chakrabarti and B. C. Pal, "Interfacing Synchronous Machine Model Including Stator Transients with Network for Stability Studies," *IEEE Transactions on Power Systems*,
147. D. Lekshmi J, Z. H. Rather and B. C. Pal, "Online Estimation of Disturbance Size and Frequency Nadir Prediction in Renewable Energy Integrated Power Systems," *IEEE Transactions on Power Systems* , available through early access.
146. Y. Wang and B. C. Pal, "Destabilizing Attack and Robust Defense for Inverter-Based Microgrids by Adversarial Deep Reinforcement Learning", *IEEE Transactions on Smart Grid*, available through early access.
145. Y. Yu, O. S. Nduka, F. U. Nazir and B. C. Pal, "A Three-Stage Stochastic Framework for Smart Electric Vehicle Charging," *IEEE Access*, vol. 11, pp. 655-666, 2023.
144. Y Guo, B. C. Pal, R. A. Jabr, "Model-Free Optimal Control of Inverter for Dynamic Voltage Support," *IEEE Transactions on Power Systems*, Available through early access.

143. K. Chakravarthi, P. Bhui, N. K. Sharma and B. C. Pal, "Real Time Congestion Management Using Generation Re-dispatch: Modeling and Controller Design," *IEEE Transactions on Power Systems*, Available through early access.
142. A. S. Mir, A. K. Singh, B. C. Pal, N. Senroy and J. Tu, "Adequacy of Lyapunov Control of Power Systems Considering Modelling Details and Control Indices," *IEEE Transactions on Power Systems*, Available through early access.
141. G. Kampitsis, E. Batzelis, A. Kolokasis, E. Matioli and B. C. Pal, "A Generalized Phase-Shift PWM Extension for Improved Natural and Active Balancing of Flying Capacitor Multilevel Inverters," *IEEE Open Journal of Power Electronics* 2022.
140. G. Kampitsis, E. Batzelis, B.C. Pal, P. D. Mitcheson, "A Clamping Circuit Based Voltage Measurement System for High Frequency Flying Capacitor Multilevel Inverters", *IEEE Transactions on Power Electronics*, vol. 37, no. 10, pp. 12301-12315, Oct. 2022.
139. Y. Guo, B. C. Pal and R. A. Jabr, "On the Optimality of Voltage Unbalance Attenuation by Inverters", *IEEE Transactions on Sustainable Energy*, vol. 13, no. 3, pp. 1492-1506, July 2022.
138. Y. Cheng, L. Fan, J. Rose, F. Huang, J. Schmall, X. Wang, X. Xie, J. Shair, J. Ramamurthy, N. Modi, C. Li, C. Wang, S. Shah, B. C. Pal, Z. Miao, A. Isaacs, J. Mahseredjian, and Z. Zhou, "Real-World Subsynchronous Oscillation Events in Power Grids with High Penetrations of Inverter-Based Resources", *IEEE Transactions on Power Systems*, Available through early access.
137. F. Ul-Nazir, B. C. Pal and R. A. Jabr, "Affinely Adjustable Robust Volt/VAr Control without Centralized Computations", *IEEE Transactions on Power Systems*, Available through early access.
136. M. G. Dozein, B. C. Pal and P. Mancarella, "Dynamics of Inverter-Based Resources in Weak Distribution Grids," *IEEE Transactions on Power Systems*, vol. 37, no. 5, pp. 3682-3692, Sept. 2022.
135. Y Guo, B. C. Pal, R. A. Jabr, and H. Gua, "Global Optimality of Inverter Dynamic Voltage Support", *IEEE Transactions on Power Systems*, vol. 37, no. 5, pp. 3947-3957, Sept. 2022.
134. Nicolàs Cifuentes, M. Sun, R. Gupta and B. C. Pal, "Black-Box Impedance-Based Stability Assessment of Dynamic Interactions Between Converters and Grid," *IEEE Transactions on Power Systems*, vol. 37, no. 4, pp. 2976-2987, July 2022.
133. Nicolàs Cifuentes and B. C. Pal, "A New Approach to the Fault Location Problem: Using the Fault's Transient Intermediate Frequency Response", *IEEE Open Access Journal of Power and Energy*, vol. 8, pp. 510-521, 2021.
132. S. H. Kazmi, N. Viafora, T. S. Sorensen, T. Olesen, B.C. Pal, J. Holboll, "Offshore Windfarm Design Optimization using Dynamic Rating for Transmission Components", *IEEE Transactions on Power Systems*, vol. 37, no. 3, pp. 1820-1830, May 2022.
131. Y Liu, AK Singh, J Zhao , AP Meliopoulos , BC Pal, MAM Ariff, T Vancutsem , G Mevudin , Z Huang, I Kamwa, L Mili, MA Salim , AF Taha, V Terzija and Y Shenglong, "Dynamic State Estimation for Power System Control and Protection", *IEEE Transactions on Power Systems*. vol. 36, no. 6, pp. 5909-5921, Nov. 2021.
130. J. Liu, R. Singh and B.C. Pal "Distribution System State Estimation with High Penetration of Demand Response Enabled Loads," *IEEE Transactions on Power Systems*, vol. 36, no. 4, pp. 3093-3104, July 2021.
129. N. Hatziargyriou, J. V. Milanovic, C. Rahmann, V. Ajjarapu, C. Canizares, I. Erlich, D. Hill, I. Hiskens, I. Kamwa, B. Pal, P. Pourbeik, J. J. Sanchez- Gasca, A. Stankovic, T. Van Cutsem, V. Vittal, C. Vournas, "Definition and Classification of Power System Stability – Revisited & Extended," *IEEE Transactions on Power Systems*, vol. 36, no. 4, pp. 3271-3281, July 2021
128. B Pawar, E. I. Batzelis, S Chakrabarti, B. C. Pal , "Grid-Forming Control for Solar PV Systems with Power Reserves" , *IEEE Transactions on Sustainable Energy*, vol. 12, no. 4, pp. 1947-1959, Oct. 2021
127. J. Zhao et al., "Roles of Dynamic State Estimation in Power System Modeling, Monitoring and Operation," *IEEE Transactions on Power Systems*. vol. 36, no. 3, pp. 2462-2472, May 2021.
126. J. Nsengiyaremye, B. C. Pal, M. Begovic, "Low-Cost Back-up Line Protection for Multi-Inverter Based Microgrids," *IEEE Transactions on Power Delivery*, vol. 36, no. 6, pp. 3371-3382, Dec. 2021.

125. Y. Yu, O.S. Nduka, and B.C. Pal, "Smart Control of an Electric Vehicle for Ancillary Service in DC Microgrid", *IEEE Access*, vol. 8, pp. 197222-197235, 2020.
124. F. Ul-Nazir, B. C. Pal and R. A. Jabr, "Approximate Load Models for Conic OPF Solvers", *IEEE Transactions on Power Systems*, vol. 36, no. 1, pp. 549-552, Jan 2021.
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122. Y. Gupta, S. Doolla, K. Chatterjee and B. C. Pal, "Optimal DG Allocation and Volt-var Dispatch for a Droop Based Microgrid", *IEEE Transactions on Smart Grid*, vol. 12, no 1, 169-181, Jan 2021.
121. H.R. Ali, B. C. Pal , " Model order reduction of multi-terminal direct-current grid systems," *IEEE Transactions on Power Systems*, vol. 36, no.1. pp. 699-711, Jan 2021.
120. F. Ul-Nazir, N. Kumar, B. C. Pal, B. Singh and B.K. Panigrahi, "Enhanced SOGI Controller for Weak Grid Integrated Solar PV System," *IEEE Transactions on Energy Conversion*, vol. 35, no. 3, pp. 1208-1217, Sept. 2020.
119. F. Ul-Nazir, B. C. Pal and R. A. Jabr, " Distributed Solution of Stochastic Volt/VAr Control in Radial Networks", *IEEE Transactions on Smart Grid*, vol. 11, no. 6 pp. 5314-5324, Nov 2020.
117. Y Chen, S. M. Mazhari, C.Y. Chung, S. O. Faried and B. C. Pal, " Rotor Angle Stability Prediction of Power Systems with High Wind Power Penetration Using a Stability Index Vector", *IEEE Transactions on Power Systems*, vol. 35, no. 6, pp. 4632-4646, Nov 2020.
1. J. Nsengiyaremye, B. C. Pal, M. Begovic, "Microgrid Protection Using Low-Cost Communication Systems", *IEEE Transactions on Power Delivery*, vol. 35, no. 4, pp. 2011-2020, Aug. 2020.
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115. N. R. Meritt, C Chakraborty , P Bajpai, and B. C. Pal, "A Unified Control Structure for Grid Connected and Islanded Mode Operations of Voltage Source Converter based Distributed Generation Units under Unbalanced and Non-linear Conditions", *IEEE Transactions on Power Delivery*, vol. 35, no. 4, pp. 1758-1768, Aug. 2020.
114. O. S. Nduka, Y. Yu, B. C. Pal and E. N. C. Okafor, "A Robust Augmented Nodal Analysis Approach to Distribution Network Solution," *IEEE Transactions on Smart Grid*, vol. 11, no. 3, pp. 2140-2150, May 2020.
113. X. He, H. Geng, R. Li and B. C. Pal, "Transient Stability Analysis and Enhancement of Renewable Energy Conversion System During LVRT," *IEEE Transactions on Sustainable Energy*, vol. 11, no. 3 pp.161-1623, August 2020.
112. L. Zhang, E. Kerrigan and B. C. Pal, "Optimal Communication Scheduling in the Smart Grid", accepted in *IEEE Transactions in Industrial Informatics*, vol. 15, no. 9, pp. 5257-5265, Sept. 2019.
111. H. Ali, P. K. Linash; and B. C. Pal, V. Konstantin and A. Adamczyk, "A Trajectory Piecewise Linear Approach to Nonlinear Model Order Reduction of Wind Farms" *IEEE Transactions on Sustainable Energy*, vol. 11, no. 2, pp. 894-905, April 2020.
110. G. Anagnostou; P. K. Linash; and B. C. Pal, "Dynamic State Estimation for Wind Turbine Models with Unknown Wind Velocity", *IEEE Transactions on Power Systems*, vol. 34, no. 5, pp. 3879-3890, Sept. 2019.
109. S. Kumar, B. Singh, B. C. Pal, L. Xu and A. Al-Durra, "Energy Efficient Three-Phase Utility Interactive Residential Microgrid With Mode Transfer Capabilities at Weak Grid Conditions," *IEEE Transactions on Industry Applications*, vol. 55, no. 6, pp. 7082-7091, Nov-Dec. 2019.
108. Junbo Zhao, Antonio Gomez-Exposito, Marcos Netto, Lamine Mili, Ali Abur, Vladimir Terzija, Innocent Kamwa, Bikash Pal, Abhinav Kumar Singh, Junjian Qi, Zhenyu Huang, A. P. Sakis Meliopoulos, "Power System Dynamic State Estimation: Motivations, Definitions, Methodologies and Future Work", *IEEE Transactions on Power Systems*, vol. 34, no. 4, pp. 3188-3198, July 2019.
107. A. K. Singh and B. C. Pal , "Rate of Change of Frequency Estimation for Power Systems using Interpolated DFT and Kalman Filter", *IEEE Transactions on Power Systems*, vol. 34, no. 4, pp. 2509 - 2517, July 2019.

105. E. Batzelis, G. Anagnostou, I. R. Cole, T. R. Betts and B. C. Pal, "A State-Space Dynamic Model for Photovoltaic Systems with Full Ancillary Services Support," *IEEE Transactions on Sustainable Energy*, vol. 10 no. 3, pp. 1399 - 1409, July 2019.
104. U. Bose, S. Chattopadhyay, C. Chakraborty and B. C. Pal, "A Novel Method of Frequency Regulation in Microgrid", *IEEE Transactions on Industry Applications*, vol. 55, no. 1, pp. 111-121, January 2019.
103. H. Ali, P. K. Linash; and B. C. Pal, A. Adamczyk and V Konstantin, "Model Order Reduction of Wind Farms: Linear Approach" *IEEE Transactions on Sustainable Energy*, vol. 10, no. 3, pp. 1194 - 1205, July 2019.
102. Efstratios I. Batzelis, Georgios Anagnostou and Bikash C Pal, "A State-Space Representation of Irradiance-Driven Dynamics in Two-Stage Photovoltaic Systems", *IEEE journal of Photovoltaics*, vol. 8, no. 4, pp. 1119-1124, July 2018.
101. F. Ul-Nazir, B. C. Pal and R. A. Jabr, "A Two-Stage Chance Constrained Volt/Var Control Scheme for Active Distribution Networks with Nodal Power Uncertainties", *IEEE Transactions on Power Systems*, vol. 34, no. 1, pp. 314-325, January 2019
100. C. Lianfang, N. F. Thornhill, S. Kuenzel, and B. C. Pal, "A Test Model of a Power Grid with Battery Energy Storage and Wide-Area Monitoring", *IEEE Transactions on Power Systems*, vol. 34, no. 1, pp. 380-390, January 2019.
99. H. Kazari, H. Oraee and B. C Pal, "Assessing the Effect of Wind Farm Layout on Energy Storage Requirement for Power Fluctuation Mitigation", *IEEE Transactions on Sustainable Energy*, vol. 10, no. 2, pp. 558 - 568, April 2019.
98. Umamaheswararao V, S. Maiti, C. Chakraborty, and B. C. Pal, "Series Voltage Regulator for Radial DC-microgrid", *IEEE Transactions on Sustainable Energy*, vol. 10, no.1, pp. 127-136, January 2019.
97. E I. Batzelis, S. A. Papathanassiou and B. C Pal, "PV System Control to Provide Active Power Reserves under Partial Shading Conditions", *IEEE Transactions on Power Electronics*, vol. 33, no. 11, pp. 9163 - 9175, Nov 2018.
96. A. V. Ravi Teja, C. Chakraborty, and B C. Pal, "Disturbance Rejection Analysis and FPGA based Implementation of a Second Order Sliding Mode Controller fed Induction Motor Drive, *IEEE Transactions on Energy Conversions*, vol. 33, no. 3, pp. 1453-1462, September 2018.
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94. A. Singh and B. C. Pal, "Decentralized Robust Dynamic State Estimation in Power Systems using Instrument Transformers", *IEEE Transactions on Signal Processing*, vol. 66, no 6, pp. 1541-1550, March 2018.
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92. O. S. Nduka, and B. C. Pal, "Quantitative Evaluation of Actual Loss Reduction Benefits of a Renewable Heavy DG Distribution Network", *IEEE Transactions on Sustainable Energy*, vol. 9, no. 3, pp. 1384-1396, July 2018.
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