Buxin She

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Education

- **University of Tennessee Knoxville** — Tennessee, USA
  Ph.d Power System - Department of Electrical Engineering and Computer Science — *Jan 2020 - Now*
- **Tianjin University** — Tianjin, China
  Master Power System - School of Electrical and Information Engineering — *Sep 2017 - Dec 2019*
- **Tianjin University** — Tianjin, China
  Bachelor Power System - School of Electrical and Information Engineering — *Sep 2013 - Jun 2017*

Skills Summary

- **Power Knowledge**: Microgrid control, Inverter-based resources (IBR) modeling and control, Security-constrained economic dispatch, Distribution system plan.
- **Techniques Knowledge**: Control theory, Convex optimization, Deep learning, (Deep) Reinforcement learning.
- **Power Simulator**: Matlab/Simulink, ATP-EMTP, Andes, Pandapower/Matpower.
- **AI/Control/Optim. Toolbox**: Pytorch, Tensorflow, Sympy, Scipy, Gurobipy, CVX.

Research Part I: Microgrid control, IBR control

- **Work summary**
  I have worked on P-Q control, V-f control, transient-stability guaranteed control, and HVDC damping control.
  - **Inverter PQ Control with Trajectory Tracking Capability [1]**:
    I designed a P-Q controller for microgrid grid-following inverters with trajectory tracking capability, based on physics-informed reinforcement learning. By tuning the PI gains in real-time, the inverter output can perfectly track the predefined exponential trajectories with any time constant. I performed model-based analysis first, and then implemented the twin delayed deeper deterministic policy gradient algorithm (a model-free deep RL algorithm). The proposed algorithm was finally tested on CURENT HTB.
  - **Decentralized and Cooperated V-f Control [2]**:
    I proposed a V-f control framework for islanded microgrids, with full consideration of DER inadequacy and demand control. The control framework regulates the output of each grid-forming inverter accurately and thus improves the inverter DC side stability caused by DER inadequacy.
  - **Fusion of Model-free Reinforcement Learning (MFRL) with Microgrid Control [3]**:
    I wrote a review paper to summarize how MFRL can be integrated into the existing microgrid control framework. The contributions include: 1)Plotting of a high-level research map of microgrid control; 2)Development of modularized control blocks to dive into grid-following and grid-forming inverters; 3) Introduction of the mainstream MFRL algorithms and summary of MFRL application guidelines; 4) Discussion of the primary challenges associated with adopting MFRL in microgrid control and providing insights for addressing these concerns.
  - **Microgrid Controller Design with Certified Stability and Domain of Attraction [4]**:
    I developed a systematic controller design approach that integrates the analytical transient stability conditions to guarantee the domain of attraction, based on nonlinear state-space modeling (electromagnetic transient modeling) of islanded microgrids.*[This work was done during my **internship at Argonne National Laboratory** under the supervision of Dr. Jianzhe Liu].*
  - **Time Delay Compensation of HVDC Damping Control [5]**:
    I proposed a data-driven delay compensation approach for wide-area damping control (WADC), leveraging the modern recurrent neural network LSTM. A small signal model of WADC with time delay is formulated to analyze the impacts of time delay on WADC. It is mathematically proven that uncorrected PUM signals can result in the instability of urban power grids.

Research Part II: Security-constrained economic dispatch

- **Work summary**
  I have worked on the security-constrained economic dispatch of IBR-based microgrid/power system.
  - **Security-constrained real-time economic dispatch [6]**:
    I proposed the concept of virtual inertia scheduling (VIS) for IBR-dominant power systems. VIS is an inertia management framework that targets security-constrained and economy-oriented inertia scheduling and generation dispatch of power systems with a large scale of renewable generations. Specifically, it schedules the proper power setting points and reserved capacities of both synchronous generators and IBRs, as well as the control modes and control parameters of IBRs to provide secure and cost-effective inertia support.

- **VIS with certified stability and dynamic performance under N-1 Contingency**:
  I plan to extend the concept of VIS to microgrids under N-1 contingency, while also certifying the transient stability and dynamic performance.

Research Part III: Distribution System Operation and Plan

- **Work summary**
  I worked on the plan and operation of distribution system under the supervision of Dr.Jun Xiao at Tianjin University.
  - **Total supply and accommodation capability curves for active distribution networks**: [10]-[11]
  - **Mathematical Mechanism of Total Supply Capability Curve**: [11]
  - **Geometric property of distribution system security region: Size and shape**: [12]
  - **Operational boundary, region, and capability curve of flow network**: [13]-[15]
  - **Gas transmission capability curve of natural gas system**: [16]

Research Part IV: Thermal Energy Storage

- **Work summary**
  I participated in research led by ORNL research scientist Dr. Zhenglai Shen and his manager Dr. Som S Shrestha.
  - **Heat fluxes prediction and efficient energy management using deep learning**: [18], [20]

Review Service and Awards

- **Journal Editor**
  I am serving as the editor of the following journals.
  - Guest Student Editor: IET Renewable Power Generation
- **Journal Reviewer**
  I am serving as the reviewer of the following journals.
  - IEEE Transaction on Smart Grid
  - IEEE Transaction on Power system
  - IEEE Transaction on Sustainable Energy
  - Open Access Journal of Power and Energy
  - IET Generation, Transmission & Distribution
  - Journal of Modern Power Systems and Clean Energy
  - International Journal of Electrical Power & Energy Systems
  - Reliability engineering & system safety
  - Protection and control of modern power systems
- **Conference Reviewer**
  I served as the reviewer of the following conference.
  - IEEE PES General Meeting 2022-2023
  - IEEE IAS Industrial and Commercial Power System Asia 2023
  - IEEE IAS Annual Meeting 2023
- **Awards**
  I received the best reviewer awards from the following journals.
  - Excellent Reviewer of Journal of Modern Power Systems and Clean Energy (MPCE) 2022
  - Best Reviewer of Open Access Journal of Power and Energy (OAJPE) 2020

Publications (Visit Buxin's Google Scholar)

Journal Paper

[1] **Buxin She**, Fangxing Li*, et.al. " Inverter PQ Control with Trajectory Tracking Capability for Microgrids Based on Physics-informed Reinforcement Learning ", *IEEE Transactions on Smart Grid*, Under R1 review.

[2] **Buxin She**, Fangxing Li*, et.al. " Decentralized and Coordinated V-f Control for Islanded Microgrids Considering DER Adequacy and Demand Control ", *IEEE Transactions on Energy Conversion*, Early Access, 2023.

[3] **Buxin She**, Fangxing Li*, et.al. " Fusion of Reinforcement Learning and Microgrid Control ", *IEEE Transactions on Smart Grid*, 15 November 2022, DOI: 10.1109/TSG.2022.3222323. (**Popular paper on TSG since publication**).

[4] **Buxin She**, Jianzhe Liu*, Feng Qiu, Fangxing Li*, et.al. " Systematic Controller Design for Inverter-based Microgrids with Certified Stability and Domain of Attraction ", *IEEE Transactions on Smart Grid*, To submit.

[5] **Buxin She**, Yuqing Dong*, Yilu liu. " Time Delay of Wide Area Damping Control in Urban Power Grid: Model-based Analysis and Data-driven Compensation ", *Frontiers in Energy Research*, (2022): 526.

[6] **Buxin She**, Fangxing Li*, et.al. " Virtual Inertia Scheduling for Power Systems with High Penetration of Inverter-based Resources ". *IEEE Transaction on Sustainable Energy*, Under review.

[7] Jingqiu Zhang, **Buxin She**, Jimmy Chih-Hsien Peng*, Fangxing Li. " A distributed consensus-based optimal energy management approach in DC microgrids ", *International Journal of Electrical Power & Energy Systems*, 2022 Sep 1;140:108015.

[8] Qiwei Zhang, Fangxing Li*, Jin Zhao, **Buxin She**, " False Data Injection Attack and Corresponding Countermeasure in Multienergy Systems ". *IEEE Transaction on Power System*, Under R1 review.

[9] Hang Shuai, Fangxing Li*, **Buxin She**, Xiaofei Wang, and Jin Zhao, " Post-storm repair crew dispatch for distribution grid restoration using stochastic Monte Carlo tree search and deep neural networks, " *International Journal of Electrical Power & Energy Systems*, vol. 140, Sep. 2023.

[10] Jun Xiao, Chuanqi Wang, **Buxin She***, Fangxing Li, et.al. " Total supply and accommodation capability curves for active distribution networks: Concept and model ", *International Journal of Electrical Power & Energy Systems*, 2021 Dec 1;133:107279.

[11] Jun Xiao, Zhongwei Cai, Ziyu Liang, **Buxin She***. " Mathematical model and mechanism of TSC curve for distribution networks ", *International Journal of Electrical Power & Energy Systems*, 2022 May 1;137:107812.

[12] Jun Xiao, Shihao Zhang, **Buxin She***, et.al. " Geometric property of distribution system security region: Size and shape ", *Electric Power Systems Research*, 2022 Sep.

[13] Jun Xiao, Yuqing Qu, **Buxin She***, Chenhui Song, " Operational boundary of flow network ", Reliability Engineering & System Safety, 2022 Nov. https://doi.org/10.1016/j.ress.2022.108974.

[14] Jun Xiao, Yuqing Qu, **Buxin She***, et.al, " Critical Flow-Based Fast Algorithm for the Total Supply Capability Curve of Distribution Networks ", *Arabian Journal for Science and Engineering*, 2023.

[15] Jun Xiao, Yuqing Qu, **Buxin She***, et.al, " Complete Limits of Flow Network Based on Critical Flow: Concept, Model, Algorithm, Visualization, and Applications ", *Arabian Journal for Science and Engineering*, 2023.

[16] Jun Xiao, Chenhui Song*, Guoqiang Zu, Liangfu Lv, **Buxin She**, Xinsong Zhang, " Gas Transmission Capability Curve of Natural Gas System: Concept and Steady-state Model", *Journal of Natural Gas Science and Engineering*, 2021.

[17] Jun Xiao, Miaomiao Zhang, Linquan Bai*, **Buxin She**, Baoqiang Zhang, " Boundary supply capability for distribution systems: concept, indices and calculation ", *IET Generation, Transmission & Distribution*, 2018 Feb 8, 12(2):499-506.

[18] Zhenglai Shen, Som Shrestha*, Daniel Howard, Tianli Feng, Diana Hun, **Buxin She**, " Machine learning–assisted prediction of heat fluxes through thermally anisotropic building envelopes ", *Building and Environment*, vol. 234, 15 April, 2023.

Conference Paper

[19] Oroghene Oboreh-Snapps, Rui Bo*, **Buxin She**, Fangxing Fran Li, Hantao Cui, " Improving Virtual Synchronous Generator Control in Microgrids Using Fuzzy Logic Control ", 2022 *IEEE/IAS Industrial and Commercial Power System Asia (I&CPS Asia)*, DOI:10.1109/ICPSAsia55496.2022.9949823.

[20] Zhenglai Shen, Som Shrestha*, Daniel Howard, Tianli Feng, Diana Hun, **Buxin She**, " Machine Learning Assisted Framework to Control Thermally Anisotropic Building Envelopes in Residential Buildings ", 2022 Buildings XV International Conference, United States: N. p., 2022. Web.

[21] Jun xiao, Yuqing Qu*, Chenhui Song, Baoqiang Zhang, **Buxin She**, and Qisi Lin, " Security Region and Total Supply Capability under N-0 for Urban Distribution Network ", *2020 IEEE Power & Energy Society General Meeting (PESGM)*, page 2-6, Dec. 2020.