Jiajun (Cary) Duan

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SUMMARY

- 9+ years of academic and hands-on experience in power system and electrical engineering projects
- 7+ years of experience in machine learning and artificial intelligence development
- 20+ white papers published on the popular international industrial journals and 4 U.S. Patents
- Strong expertise in dynamic process control, deep reinforcement learning and deep learning, renewable energy interfacing, power electronic circuit design and debug, and fault analysis of power systems
- No. 1 in CodaLab Competition of Using Reinforcement Learning to Run Power Network
- Strong abilities in problem-solving, critical thinking, fast learning, teamwork and taking the initiative of work

EDUCATION BACKGROUND

05/2019-now: **Research Scientist, AI& System Analytics,** GEIRINA Inc.

05/2018-05/2019: **Postdoctoral, AI& System Analytics,** GEIRINA Inc.

01/2014-05/2018: **Ph.D.**, **Electrical and Computer Engineering**, Lehigh University, GPA: 3.85

09/2013-01/2014: **M.Eng**, **Electrical and Computer Engineering**, Lehigh University, GPA: 3.80

08/2009-06/2013: **B.Eng**, **Power Systems and Automation**, Sichuan University (Honor College), GPA: 3.70

SKILLS

- Design & Simulation: Simulink, RT-Lab, Labview, PowerWorld, EMTP, PVsyst, PSPICE
- Programming: Python, MATLAB, C++, PAMPL, AutoCAD, Microsoft Office

PROJECT & INTERNSHIP EXPERIENCE

DRL-based Control in Power System, GEIRINA Inc., CA – *Power System Research Scientist* 06/2018-now

- Developed the optimal energy management system (EMS) for GEIRINA building microgrid with 20 kW roof-top solar and 30 kW energy storage systems.
- Introduced the concept of Alpha Zero to power system operation and developed an autonomous optimal control platform, *"Grid Mind"*, for power system using the cutting-edge deep reinforcement learning (DRL) methods such as DQN, DDPG, A3C and PPO etc.
- Leading team from proposal preparation to production delivery. Achieved sub-second autonomous control under complex and unknown operating conditions of power system.
- Representing GEIRINA participated in the AI competition in CodaLab organized by RTE France, i.e. learn to run a power grid using DRL. Won the 1st place over 100 teams from all around the world.
- Developed and implemented the AI-based power system control software and cloud platform with RTE France and State Grid of China etc.

Power Electronics and Microgrids, SMRT-Lab, Lehigh University, PA - Ph.D. *Research Assistant* 01/2015-05/2018

- Developed an adaptive microgrid management systems. The secondary and primary controllers are designed in a decentralized way to realize proper load sharing and plug-and-play functions with unknown system parameters. The proposed control can guarantee that the desired generation references of tertiary control can be accurately achieved.
- Reduced the overshoot of transient voltage/current up to 30% for AC/DC microgrids with inverter-interfaced DGs based on advanced control designs. Performed the switch-level real-time simulation using RT-Lab.
- Resolved the impact of pulsed power load and energy storage in the shipboard power system by introducing and applying the Zero-Sum Game Theory. Accomplished the demonstration with both real-time simulation and hardware-in-the-loop experiments.
- Achieved optimal control of parallel uninterruptible power supply (UPS) system by designing a Neuro Network algorithm to train the unknown system dynamics.

16.5 MW PV System Project, Conti Corp Inc., MA- *Intern Design Engineer* 05/2016-08/2016

- Collaborated in designing a hybrid PV panel deployment solution and reduced the total cost by over $9 million, with consideration of shading, power balancing and converter matching constraints.
- Supervised and interacted with 12 subcontracting companies to achieve the project milestones.

- Mapped over 70,000 barcodes including solar panels, inverters, and optimizers into 1,603 subsystem drawings with AutoCAD, and composed placed-in-order letters and safety reports.

Wide-Area Power Systems Management, CNet-Lab, TAMU-CC, TX -*Visiting Scholar* 06/2015-02/2016

- Collaborated with faculties in TAMU-CC to develop the novel control system for large-scale power systems with high robustness against cyber and physical system uncertainties.
- Aiming at reducing the communication and computation burden over 50%, while increasing the system robustness even with the packet drop rate and delay rate as high as 70%.
- Designed and implemented Reinforcement Learning, Optimal, and Event-Triggering control algorithms etc. into wide-area power systems.
- Performed the real time simulation of IEEE-14 bus, IEEE-30 bus and IEEE-118 bus systems using PowerWorld and RT-Lab to test the developed control algorithms.

HONORS & CERTIFICATE

- No. 1 in RTE L2RPN Competition of Reinforcement Learning in Power Network Management.
- Best Paper Reward of IEEE PES General Meeting 2019
- Best Graduate Student Teaching Assistant Award 2017 of Lehigh University
- Rossin Doctoral Fellows of Lehigh University 2017
- Best Reviewers 2016 and 2017 of IEEE TSG (http://ieeexplore.ieee.org/document/7792798/)

U.S. PATENT

- Data-driven multi-agent autonomous control framework based on deep reinforcement learning (US 62/933,194)
- An approach for autonomous voltage control for grid operations using deep deterministic policy gradient (US 62/833,776)
- Autonomous voltage control for power system using deep reinforcement learning considering N-1 contingency (US 62/744,217)
- Optimal charging and discharging control for hybrid energy storage system based on reinforcement learning (US 62/739,465)

SELECTED PUBLICATIONS

1. **J. Duan**, D. Shi, R. Diao et al, "Deep-reinforcement-learning-based autonomous voltage control for power grid operations," *IEEE Transactions on Power Systems, 2019.*
2. **J. Duan,** H. Xu, and W. Liu, "Q-learning based damping control of wide-area power systems under cyber uncertainties," *IEEE Transactions on Smart Grid, 2017.*
3. **J. Duan,** C. Wang, H. Xu, Y. Xue and W. Liu, "Distributed control of inverter-interfaced microgrids based on consensus algorithm with improved transient performance," *IEEE Transactions on Smart Grid*, 2018.
4. **J. Duan,** H. Xu, and W. Liu, "Distributed control of inverter-interfaced microgrids with bounded transient line currents," *IEEE Transactions on Industrial Informatics*, 2018.
5. **J. Duan**, L. Cheng, and K. Zhang, "A novel method of fault location in single-phase microgrids," *IEEE Transactions on Smart Grid,* 2016.
6. **J. Duan,** H. Xu, and W. Liu, "Zero-sum-game based control design for onboard pulsed power load and experiment with multiple converters," *IEEE Transactions on Industrial Informatics*, 2019.
7. **J. Duan**, Z. Yi, D. Shi, and Z. Wang, "Reinforcement-learning-based optimal control for hybrid energy storage systems in hybrid AC/DC microgrids", IEEE Transactions on Industrial Informatics, 2019.
8. **J. Duan,** H. Xu, and W. Liu, "Event-triggered and self-triggered wide-area damping control designs under uncertainties," *Transactions of the Institute of Measurement and Control, 2016.*
9. S. Wang, **J. Duan**, D. Shi, "A Data-driven multi-agent autonomous voltage control framework using deep reinforcement learning," IEEE Transactions on Power Systems, 2020.
10. C. Wang, **J. Duan,** Q. Yang and W. Liu, "Decentralized high-performance control of DC microgrids," *IEEE Transactions on Smart Grid,* 2018.
11. R. Diao, Z. Wang, D. Shi, Q. Chang, **J. Duan**, and X. Zhang, "Autonomous Voltage Control for Grid Operation Using Deep Reinforcement Learning," *IEEE PES General Meeting,* 2019 **(IEEE PES Best Paper).**