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# Curriculum Vitae – Yang Zilong

## Personal details

Name: Yang Zilong

Sex: Male

Date of birth: 19<sup>th</sup> October 1980

Nationality: P. R. China

Contact information:

Renewable Energy Research and Development Center

Institute of Electrical Engineering

Chinese Academy of Science

Room 408, Building 2, No.6, Beiertiao, Zhongguancun, Haidian District, Beijing, China

Phone : +86 18801022656 E-mail : yangzl@mail.iese.ac.cn



## Education

**PhD in Electronics and Electrical Drivers** [Sept.2006 - Jan.2010]

Supervisor: Xu Honghua

School: Institute of Electrical Engineering, Chinese Academy of Science, Beijing, China

**MSc in Electronics and Electrical Driver** [Sept.2003.9 - Jul.2006]

Supervisor: Gu Herong

School: Yanshan University, Hebei Province, China

**BEng in Electrical Engineering** [Sept.1999 - Jul.2003]

School: Agriculture University of Hebei Province, China

## Work Experience

### Associate Professor

Jan.2016 - Now

Renewable Energy Research and Development Center

Institute of Electrical Engineering, Chinese Academy of Science

### Assistant Professor

Mar.2010 - Dec. 2105

Renewable Energy Research and Development Center

Institute of Electrical Engineering, Chinese Academy of Science

## Scientific Focus Areas

- Energy management system in distributed PV system and Micro-grid
- Integration technologies of hybrid energy systems based on renewable energy
- Energy storage technologies in distributed generation system

## Projects Experience

1. **Project Title:** Research on Key Technology of Micro-Grid System Comprising Multi-Renewable Energy Resources Based on Solar Energy

**Funder:** National High-tech R&D Program (863 Program). 6,880,000CNY.

**Period:** April, 2015 ~ July, 2018

**Project Description:** Oriented development needs of low-carbon green Chinese new rural communities, project planning and design, intelligent control / inverter, energy and efficiency management for house, building and community, demand side response and other key technologies were researched and developed in this project. And then export the implementation plan to construct a new rural community micro-grid

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system with 60% penetration renewable energy, CCHP, efficient energy storage, MW scale. Form a suitable strategy for popularizing and applying renewable energy in towns and villages in western China.

**My Work:** As **Principal investigator**, be in charge of project application and implementation, developing software and hardware products about energy management system, organizing the demonstration in Qinhai Province of China.

2. **Project Title:** Research on Coordinated Control of High Penetration of Photovoltaic Sources interconnected onto the Distribution Power System

**Funder:** National High-tech R&D Program (863 Program). 28,980,000CNY.

**Period:** January,2012 ~ December, 2014

**Project Description:** The Institute of Electrical Engineering, Chinese Academy of Science (IEECAS), China Electric Power Research Institute (EPRI), Beijing Corona Science & Technology Co., Ltd, Tianjing University, Shanghai University of Electric Power, China Longyuan Power Group Co., Ltd have teamed together to research and develop many key technologies and devices about high-penetration levels of photovoltaic (PV) resources interconnected onto the distribution system. Specifically, the project relies on 10MW Building Attached Photovoltaic (BAPV) system. Research efforts under this project include:

- ♦ Stability control of distribution power grid with high-penetration levels of photovoltaic (PV)
- ♦ Power quality conditioner technology and its application on distributed networks
- ♦ Protection of power electronically interfaced distributed PV station networks
- ♦ Intelligent energy management system.

**My Work:** As **Project Core Participant**, be in charge of developing energy manage system for battery station; design the monitoring devices for all the scattered PV stations; built the anti-island experiment platform; study communication technologies to support the protection and control strategies.

3. **Project Title:** Demonstration and Research on Key Technology of Comprehensive Automation System in MW Scale PV Station in Micro-grid

**Funder:** Chinese Academy of Science. 3,000,000 CNY.

**Period:** January,2011 ~ December, 2013

**Project Description:** This project aim to develop an integrated automation system for schedulable PV station in order to improve real-time data acquisition, photovoltaic forecasting, design optimal dispatch strategy of active and reactive power, enable coordinated operation of multi-inverter, improve fault diagnosis and protection, and finally demonstrate an optimal designed energy management system into a PV station in Qinhai Province, China.

**My Work:** As **Project Manager**, be in charge of organization and implementation of software and hardware products development, such as supervisory control and data acquisition (SCADA) systems, auto generator controller (AGC), auto voltage controller (AVC), battery management system (BMS), and verification test above system in demonstration.

4. **Project Title:** Demonstration and Research on Key Technology of 300kW Hydro/PV Hybrid Power System

**Funder:** Chinese Academy of Science. 9,600,000CNY.

**Period:** July,2009 ~ June, 2012

**Project Description:** The project purpose is to research key technologies about hybrid hydro/PV generating system, the most important original contributions expected are as follows:

- ♦ Research on optimization design of PV/battery station and simulation
- ♦ Develop new PV inverter that can parallel operation with synchronous machine
- ♦ Study the management and control equipment for large scale storage system

- ♦ Intelligent energy management system and schedulable strategy for hybrid hydro/PVsystem
- ♦ Demonstrate the related technologies and devices in a hybrid generating system.

**My Work:** As **Project Core Participant**, be in charge of designing the energy management system of hydro/PV hybrid power system, particularly with respect to simulation models of hybrid system, capacity configuration for schedulable PV station, scheme design of monitoring system for the station, design of optimal operation mode of PV/battery/hydro power.

5. **Project Title:** Research on Key Technology of Parallel PV Generation System

**Funder:** Chinese Academy of Science. 3,800,000CNY.

**Period:** October, 2008 ~ September, 2010

**Project Description:** This project aims to develop the wireless parallel control of inverter and high efficiency battery charger with MPPT for PV/battery Generation System, the most important original contributions expected are as follows:

- ♦ Improved wireless parallel control method for battery-inverter
- ♦ 100kW level DC/DC battery-charger with high efficiency MPPT strategy
- ♦ Control strategies for parallel system involving battery-inverters and conventional generators
- ♦ Development of PV-design software.

**My Work:** As Project Core Participant, be in charge of develop 10kW three-phase dual-mode inverters, which can be operated in grid-connected mode and stand-alone mode, also can seamless transform between two modes. Base on this experimental platform, proposed a new frequency-droop and amplitude-droop scheme to realize wireless parallel operation, and designed a composite control strategy to make the inverter have the capacity to equip with unbalanced load. The research achievements above were verified by 100kW inverters in 2MW PV station.

6. **Project Title:** Research on Key Technology of Grid-Connected PV System in Chinese Western

**Funder:** Chinese Academy of Science. 4,500,000CNY.

**Period:** April, 2007 ~ August, 2008

**Project Description:** This project aims to research the relation between grid-connected PV station and high voltage power grid, to develop 500kW high efficiency and high voltage inverter for MW scale grid-connected PV station, to demonstrate and compare various tracking system of PV array include double axes and single axis, to design dual-mode inverter and realize seamless transition between on-grid and off-grid. Finally, these systems were demonstrated in Tibet, China.

**My Work:** As Project Participant, be in charge of developing 3kW photovoltaic grid-connected inverter and 5kW dual-mode inverter, involving designing schematics, drawing PCB, programming on DSP, on-site installation, debugging and maintains. Five inverters were installed in Tibet, and 28 inverters installed in Olympic Park.

## Publications

**Master Degree Thesis:**

Research on Control Technology of Double-mode Inverter with Grid-connected Mode and Stand-alone Mode

**Doctoral Academic Dissertation:**

Research on Parallel Control Technology of Self-Synchronous Inverter

**Journal Papers:**

1. Yong Zhao, **Zilong Yang**, Yibo Wang and Ying Zhang. Mechanism Analysis of PCC Harmonic Resonance Based on Nonlinear Self-Oscillation Concept in a High-Power Grid-Tied Photovoltaic Plant. Applied Sciences. 2018, 8(9), 1507

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2. Mingyu Lei; **Zilong Yang**; Yibo Wang; Honghua Xu; Lexuan Meng; Juan Vasquez; Josep M. Guerrero. A MPC Based ESS Control Method for PV Power Smoothing Applications. IEEE Transactions on Power Electronics. 2018, 33(3): 2136 - 2144
3. Sun Zhenao, **Yang Zilong**, Zhao Yong, Wang Yibo, Xu Honghua. The Cause Analysis and Suppression Method of Resonances in Clustered Grid-Connected Photovoltaic Inverters[J] Proceedings of the CSEE (Chinese), 2016, 36 (13) :3590-3597
4. Lei Mingyu, **Yang Zilong**, Wang Yibo, Xu Honghua. Application of Improved Slip Mode Frequency Shift Method in Islanding Detection of Multi-Grid-Connected Inverter Cluster[J]. Power System Technology (Chinese), 2016, 31 (23): 86-92
5. Lei Ming-yu, **Yang Zi-long**, Wang Yi-bo , Xu Hong-hua. “Study on Control Technology of Energy Storage Station in Photovoltaic/Storage System”, Transactions of China Electrotechnical Society, Vol. 31 No. 23, pp.87-92, 2016
6. Sun Zhenao, **Yang Zilong**, Wang Yibo, Xu Honghua. A hybrid islanding detection method for distributed multi-inverter systems. Proceedings of the Chinese Society of Electrical Engineering (Chinese), 2016, 36(13): 3590-3597
7. **Yang Zilong**, Wang Yibo. Research on Measurement and Control Technology for PV Power Generation Sysem. Acta Energiæ Solaris Sinica(Chinese), 2015, 36(4): 1023-1028
8. Sun Zhenao, **Yang Zilong**, Wang Yibo, Xu Honghua. Distribution Network Reactive Power Voltage Control for Photovoltaic Power System[J]. Power Electronics Technology (Chinese). 2013, 47(10): 40-42.
9. Xue Huijie, Wang Haoyi, **Yang Zilong**, Xu Honghua. “State feedback control of three-phase grid-connected PV inverter isolated by line-frequency transformer,” Renewable Energy Resources (Chinese), Vol.30 No.7, Jul. 2012.
10. **Yand Zilong**, Wu Chun-sheng, Wang Huan. “Design of Three-Phase Inverter system with Double Mode of Grid-Connection and Stand-Alone,” Power Electronics Technology (Chinese), Vol.44 No.1 Jan.2010:14-16.
11. **Zilong Yang**, Yanchang Peng, Huan Wang, Honghua Xu. “Design of Solar Street Lamp System with Super capacitors as Energy Storage Device,” Renewable Energy Resources (Chinese), Vol.27 No.2, Apr.2009:59-61.
12. Gu He-rong; **Yang Zi-long**; Wu Wei-yang. “Research on Hysteresis-band Current Tracking Control of Grid-connected Inverter,” Proceedings of the CSEE (Chinese), Vol.26 No.9 May 2006.

**Conference Papers:**

13. **Zilong Yang**, Zhe Wang, Ying Zhang, Zhe Zhang. Topology and control of transformerless high voltage grid-connected PV systems with a cascade step-up structure. 43rd Annual Conference of the IEEE Industrial Electronics Society (IECON 2017)
14. **Yang, Zilong**, Chen, Zhuo, Guo, Lidong, Chen, Yuanyuan, Huang, Xinke, Wang, Yibo. Design Techniques of Distributed Photovoltaic/Energy Storage System. 2017 20th International Conference on Electrical Machines and Systems, (ICEMS 2017)
15. Yuanyuan Chen, **Zilong Yang**, Yibo Wang, Lidong Guo , Xinke Huang. State of Charge Estimation of Lead-carbon Batteries in Actual engineering. 2017 20th International Conference on Electrical Machines and Systems, (ICEMS 2017)
16. Mingyu Lei, **Zilong Yang**, Yibo Wang, Honghua Xu, Lexuan Meng, Juan Vasquez, Josep M. Guerrero. Design of energy storage control strategy to improve the PV system power quality. Conference of the IEEE Industrial Electronics Society, (2016)
17. Yong Zhao, **Zilong Yang**, Dufeng Cao, Yibo Wang , Honghua Xu. Analysis of PCC point harmonics caused by nonlinearities of grid-tied PV inverters[C]. 4th International Conference on Energy, Environment and Sustainable Development (EESD 2014), October, 2014, Nanjing. China.

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18. Zhao Yong, **Yang Zilong**, Zhenao Sun, Wang Yibo, Xu Honghua. Measurement and investigation of PCC point harmonics in a grid-tied PV station[C]. IEEE Transportation Electrification Conference Asia-Pacific (ITEC Asia-Pacific 2014), August, 2014, Beijing, China..
  19. Sun Zhenao, **Yang Zilong**, Wang Yibo, Xu Honghua. Investigation of Active Voltage Control Methods for Photovoltaic Inverters Connected to Network[C]. IEEE Transportation Electrification Conference Asia-Pacific (ITEC Asia-Pacific 2014), August, 2014, Beijing, China.
  20. Sun Zhenao, **Yang Zilong**, Wang Yibo, Xu Honghua. Analysis of Harmonic Resonances Among Parallel Grid-Connected Inverters[C]. 2014 International Conference on Power System Technology (POWERCON), October, 2014 Chengdu, China.
  21. Lei Mingyu, **Yang Zilong**, Wang Yibo, Xu Honghua. Study on Control Strategy of Energy Storage System in Photovoltaic Microgrid[C]. 2014 International Conference on Power System Technology (POWERCON), October, 2014 Chengdu, China.
  22. Wang, Huan; **Yang, Zilong**. "Design and implement of three-phase inverter system with double mode of grid-connection and stand-alone," Applied Mechanics and Materials, v 130-134, 2012, Mechanical and Electronics Engineering III, 4265-4269.
  23. Yajuan Guan, Yibo Wang, **Zilong Yang**, Rui Cao, Honghua Xu. "Control strategy for autonomous operation of three-phase inverters dominated microgrid under different line impedance," 2011 International Conference on Electrical Machines and Systems (ICEMS), August 2011.
  24. Huijie Xue, Wei Feng, **Zilong Yang**, Chunsheng Wu, Honghua Xu. "Improved Predictive Control of Grid-Connected PV inverter with LCL Filter," 2011 International Conference on Electric and Electronics, Communication Systems and Information Technology, (EEIC2011), 2011.
  25. Chunsheng Wu; Hua Liao; **Zilong Yang**; Yibo Wang; Honghua Xu; , "Voltage and frequency control of inverters connected in parallel forming a micro-grid," 2010 International Conference on Power System Technology (POWERCON), 24-28 Oct. 2010.
  26. **Zilong Yang**; Chunsheng Wu; Hua Liao; Yibo Wang; Huan Wang; , "Research on hydro/photovoltaic hybrid generating system," 2010 International Conference on Power System Technology (POWERCON), 24-28 Oct. 2010.
  27. Huan Wang, Yanchang Peng, **Zilong Yang**. "Analyzing the key technologies of large-scale application of PV grid-connected systems," 2010 International Conference on Power System Technology (POWERCON), 24-28 Oct. 2010.
  28. **Zilong Yang**, Chunsheng Wu, Hua Liao, Honghua Xu. "Design of energy management system in distributed power station," International Conference on Sustainable Power Generation and Supply, 2009. SUPERGEN '09, 6-7 April 2009.
  29. **Zilong Yang**, Hua Liao, Chunsheng Wu, Honghua Xu. "Analysis and selection of switch for double modes inverter in micro-grid system," International Conference on Electrical Machines and Systems, 2008. ICEMS 2008, 17-20 Oct. 2008.
  30. Chunsheng Wu, Weifeng Zhu, **Zilong Yang**, Hua Liao, Zhenguo Xu, Honghua Xu. "Design and implementation of modular three-phase utility-interactive converter," International Conference on Electrical Machines and Systems, 2008. ICEMS 2008, 17-20 Oct. 2008.
  31. Herong Gu, **Zilong Yang**, Deyu Wang, Weiyang Wu. "Research on Control Method of Double-Mode Inverter with Grid-Connection and Stand-Alone," CES/IEEE 5th International on Power Electronics and Motion Control Conference, 2006. IPEMC 2006, 14-16 Aug. 2006.