Faa-Jeng Lin (林法正)　IEEE /IET/CIEE Fellow
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Aug. 2, 2024

Professor Lin is currently Chair Professor at the Department of Electrical Engineering, National Central University (NCU), Taiwan. He is also Deputy Minister, National Science and Technology Council (NSTC), Taiwan, and Executive Director, Taiwan Power Company. His research interests include AC motor servo drives, photovoltaic power generation systems, wind turbine generation systems, smart grid, intelligent control theories (fuzzy systems, neural networks and evolutionary computation), nonlinear control theories (adaptive and sliding-mode), control theory applications, inverters/converters, and DSP-based computer control systems. For the past 30 years, he has published nearly 236 SCI journal papers including 113 IEEE Trans. Papers, 147 conference papers and 19 patents in the areas of intelligent control, nonlinear control, motor drives, renewable energy and smart grid. His H-index of 64 in Google Scholar reflects more than 13055 citations. Moreover, his work has been widely cited. Several of these papers have helped to establish research areas such as fuzzy neural network control of motor drives and motion control systems, and intelligent control of renewable energy resources. He has been elevated to Fellow by the IEEE in 2017. Additionally, He was President, National Applied Research Laboratories (NARLabs), Taiwan, from 2022 to 2024; Dean, College of Electrical Engineering and Computer Science, NCU, from 2021-2022.

Areas of Research

1. Synchronous and induction motor servo drives (rotating and linear)
2. Renewable energy systems
3. Microgrid and smart grid
4. Intelligent control systems including fuzzy, neural network and evolutionary computation
5. Nonlinear and adaptive control
6. Power electronics
7. Magnetic levitation
8. Piezoceramic actuator
9. DSP-based computer control systems and computer interface
10. Digital and analog circuits, VHDL, Spice

Education

1993　Ph. D. Electrical Engineering, National Tsing-Hua University.

1985 M. Sc. Electrical Engineering, National Cheng-Kung University.
1983 B. Sc. Electrical Engineering, National Cheng-Kung University.

Professional Experience

2024- Board Director, National Chung-Shan Institute of Science and Technology (NCSIST)
2024- Vice Minister, National Science and Technology Council (NSTC), Taiwan
2022-2024 President, National Applied Research Laboratories, Taiwan
2023- Board Director, National Atomic Research Institute, Taiwan
2021-2022 Dean, College of Electrical Engineering and Computer Science, National Central University
2021-2024 Board Director, United Renewable Energy Company, Taiwan
2019-2021 Member, Science and Technology Policy Advisory Office, Board of Science & Technology, Executive Yuan, Taiwan
2017- Executive Director, Taiwan Power Company
2017-2021 Adjunct Research Fellow, Office of Science and Technology, Executive Yuan, Taiwan
2016-2021 Board Director, Taiwan Electric Research and testing Center
2013-2017 Director, United Research Centers, National Central University
2010-2019 Chair, Smart Grid Focus Center, National Energy Project I and II, Taiwan
2010- Chair Professor, Department of Electrical Engineering, National Central University
2007-09 Chair, Power Engineering Division, National Science Council, Taiwan
2007-09 Distinguished Professor, Department of Electrical Engineering, National Central University
2006-07 Dean, Office of Academic Affairs, Professor, Department of Electrical Engineering, National Dong Hwa University
2003-05 Dean, Office of Research and Development, Professor, Department of Electrical Engineering, National Dong Hwa University
2001-03 Professor and Chairperson, Department of Electrical Engineering, National Dong Hwa University
1998-01 Professor, Department of Electrical Engineering, Chung Yuan Christian University
1993-98 Associate professor, Department of Electrical Engineering, Chung Yuan Christian University
1989-90 Lecturer, Department of Electrical Engineering , Lien-Ho Institute of Technology
1988-89 Group Leader, Chung-Shan Institute of Science and Technology (CSIST)
Develop the following system: 1. Automatic testing system for missile. 2. Single board computer system. 3. Measurement and testing of aerodynamic control system.
1987 Testing Engineer, CSIST division at Fort Worth, Texas, U.S.A.
Test and design avionics system - MFD, HUD etc.
1985-86 Software and Hardware Engineer, CSIST

Awards

1. Excellent Research Award, National Science Council, Taiwan, 1993 to 2000.
2. Outstanding Research Professor Award, Chung Yuan Christian University, Taiwan, 2000
3. Excellent Young Electrical Engineer Award, the Chinese Electrical Engineering Association, Taiwan, 2000.
4. The Crompton Premium Best Paper Award, the Institution of Electrical Engineers (IEE), United Kingdom, 2002.
5. Best Paper Award, Taiwan Power Electronics Conference, Taiwan, 2004~2006, 2009, 2011.
6. Outstanding Research Award, National Science Council, Taiwan, 2004.
7. Outstanding Research Professor Award, National Dong Hwa University, Taiwan, 2004.
8. Outstanding Technology Award, Precision CNC Servo Competition, Ministry of Education, Taiwan, 2004.
9. Outstanding Professor of Electrical Engineering Award, the Chinese Electrical Engineering Association, Taiwan, 2005.
10. Fellow, The Institution of Engineering and Technology (IET, former IEE), 2007.
11. Distinguished Professor, National Central University, Taiwan, 2008.
12. Project for Outstanding Researcher, National Science Council, Taiwan, 2008.
13. Best Paper Award, Applications Competition of Matlab/Simulink, Taiwan, 2009.
14. Chair Professor, National Central University, Taiwan, 2010.
15. Outstanding Research Award, National Science Council, Taiwan, 2010.
16. Outstanding Automatic Control Engineering Award, Chinese Automatic Control Society, Taiwan, 2011.
17. Best Paper Award, Applications Competition of Texas Instrument Asia, Taiwan, 2012.
18. Chair Professor, National Central University, Taiwan, 2013.
19. Outstanding Contribution Award, Power Engineering Division, National Science Council, Taiwan, 2013.
20. Outstanding Research Award, National Science Council, Taiwan, 2013.
21. Best Paper Award, Industrial Technology Research Institute, Taiwan, 2013.
22. The second place, Texas Instruments innovation challenge DSP/MPU Design Contest 2014, Taiwan.
23. Excellent Patent Award, National Central University, Taiwan, 2014.
24. Excellent Patent Award, National Central University, Taiwan, 2015.
25. Outstanding Professor of Engineering Award, the Chinese Institute of Engineers, Taiwan, 2016.
26. Chair Professor, National Central University, Taiwan, 2016.
27. Excellent Patent Award, National Central University, Taiwan, 2016.
28. The Most Cited Researchers in Electrical and Electronic Engineering: Developed for ShanghaiRanking's Global Ranking of Academic Subjects 2016 by Elsevier
29. Best Paper Award, R. O. C. Symp. on Electrical Power Eng., 2016

30. Fellow, The Institute of Electrical and Electronics Engineers (IEEE), 2017
31. Project for Research Fellow, MOST, 2017
32. Excellent Patent Award, National Central University, Taiwan, 2018.
33. Excellent Technology Transfer Award, National Central University, Taiwan, 2018.
34. Chair Professor, National Central University, Taiwan, 2019.
35. Honorary Chair Professor, National Chin-Yi University of Technology, Taiwan, 2019.
36. Best Paper Award, Proc. 17th Taiwan Power Electronics Conference, 2020
37. Best Paper Award, 41th R. O. C. Symp. on Electrical Power Eng., 2020
38. Excellent Technology Transfer Award, National Central University, Taiwan, 2020.
39. Project for Research Fellow, MOST, 2020
40. Outstanding Research Fellow Award, MOST, Taiwan, 2021.
41. Excellent Industry and University Cooperation Award, National Central University, Taiwan, 2022.
42. Chair Professor, National Central University, Taiwan, 2022.
43. 29th TECO Award, 2022.
44. Fellow, The Chinese Institution of Electrical Engineering (CIEE), Taiwan, 2022.
45. Fellow, Asia-Pacific Artificial Intelligence Association (AAIA), 2023.
46. Outstanding Contribution Award of Power Electronics, Taiwan Power Electronics Association, 2023.

Academic Activities

IEEE Activities

1. Member of IEEE SMC, IE and CIS Fellow Evaluating Committee (2018-)
2. Keynote Speaker, IEEE International Conference on Intelligent Green Building and Smart Grid (IEEE IGBSG), China Three Gorges University, Sep., 2019
3. Speaker, IEEE SMC Beijing Capital Region Chapter Seminar, University of Science and Technology Beijing, Nov. 12, 2018
4. Keynote Speaker, IEEE International Conference on Intelligent Green Building and Smart Grid (IEEE IGBSG), Taiwan, Apr. 22-25, 2018
5. Program Committee Member, IEEE International Conference on Fuzzy Systems (FUZZ-IEEE 2017), 2017
6. Honorary General Co-Chair, 3rd IEEE International Future Energy Electronics Conference (IFEEC), 2017
7. IEEE Fellow (2017-)
8. Associate Editor, IEEE Trans. Power Electronics (PE) (2016-)
9. Honorary Technical Program Chair, 2nd IEEE International Future Energy Electronics Conference (IFEEC), 2015
10. Technical Co-Chair, FUZZ-IEEE 2014
11. Honorary Technical Program Chair, 1st IEEE International Future Energy Electronics Conference (IFEEC), 2013
12. Chair, Taipei Chapter, IEEE Computational Intelligence Society (2012-2015)

13. Chair, Fuzzy Systems on Renewable Energy, Special Session in FUZZ-IEEE 2011, 2012, 2013, 2014, 2016 and 2017
14. Chair, Student Activities and Award Committee, FUZZ-IEEE 2011
15. Associate Editor, IEEE Trans. Fuzzy Systems (FS) (2011-2018)
16. Chair, Task Force on Fuzzy Systems on Renewable Energy, Fuzzy Systems Technical Committee, IEEE Computational Intelligence Society (2010-2017)
17. ADCOM candidate, IEEE CIS, 2010
18. Technical Committee Member, Fuzzy Systems Technical Committee, IEEE Computational Intelligence Society (2010-)
19. Program Committee Co-Chair, IEEE Power Electronics and Drives System Conference (2009)
20. Officer, Student Activities, IEEE Taipei Section (2009-2010)
21. Director, IEEE Taipei Section (2009-2010)
22. Chair, Taipei Chapter, IEEE Industrial Electronics and Power Electronics (IE/PEL) Society (2007-2010)
23. IEEE Senior Member (1999-)
24. IEEE Member (1993-1999)

<u>IEEE-Sponsored Conference Activities</u>

1. General Co-Chair, The 2018 International Automatic Control Conference (CACS 2018), Taoyuan City, Taiwan
2. General Co-Chair, International Conference on Fuzzy Theory and Its Applications (iFUZZY), 2017
3. Program Co-Chair, International Conference on Fuzzy Theory and Its Applications (iFUZZY), 2015
4. General Co-Chair, International Conference on Fuzzy Theory and Its Applications (iFUZZY), 2013
5. Exhibition Committee Co-Chair, International Conference on System Science and Engineering (2010, sponsored by IEEE CIS Taipei Chapter)
6. Award Committee Chair, Best Students' Papers Awards, Taiwan Power Electronics Conference (2009, sponsored by IEEE IE/PEL Taipei Chapter)
7. Award Committee Chair, Best Students' Papers Awards, R. O. C. Symposium on Electrical Power Engineering (2009, sponsored by IEEE IE/PEL Taipei Chapter)
8. Organizing Committee Member, R. O. C. Symposium on Electrical Power Engineering (2006-, sponsored by IEEE IE/PEL Taipei Chapter)
9. Organizing Committee Member, Taiwan Power Electronics Conference (2006-, sponsored by IEEE IE/PEL Taipei Chapter)
10. Program Committee Member, Conference on Fuzzy Theory and Its Applications, Taiwan (2002-)

<u>Non-IEEE Acitivities</u>

1. General Co-Chair, International Conference "Green Energy and Smart Grids" August 6-10, 2018, Irkutsk, Russia
2. Member of International editorial board, Energy Systems Research, Melentiev

Energy Systems Institute, SB RAS.

3. Chair, SBRAS-MOST Joint Symposia, 2017 GREEN ENERGY: SMART GRID
4. Honorary President, Taiwan Smart Grid Industry Association (2018-)
5. Chair, SBRAS-MOST Joint Symposia, 2016 Interdisciplinary Research for Sustainable Development of Energy and Environment
6. President, Taiwan Smart Grid Industry Association (2012-2016)
7. Committee Member, Smart Grid Master Plan, Ministry of Economic Affairs, Taiwan (2011-)
8. Member of Assessment Committee of Universities, Ministry of Education, Taiwan (2011-2012)
9. Vice President, Taiwan Smart Grid Industry Association (2010-2011)
10. Chair and PI, Smart Grid and AMI, National Energy Project, National Science Council, Taiwan (2010-2018)
11. Director, The Chinese Automatic Control Society, Taiwan (2010-2011)
12. Chair, Power Engineering Division, National Science Council, Taiwan (2007-2009)
13. Regional Editor – Asia Pacific, IET Electric Power Applications (2009-2017)
14. Keynote Speaker, Australia Universities Power Engineering Conference (2008)
15. Accreditation Member, Institute of Engineering Education, Taiwan (2007-)
16. Editorial Board, IET Electric Power Applications (2005-2008)
17. Member of Assessment Committee of Universities of Science and Technology, Ministry of Education, Taiwan (2005-2016)
18. International Steering Committee Member, IET Linear drives and Industrial Applications Conference (LDIA) (2003-2016)
19. Editor-in-Chief, Journal of Power Electronics, Taiwan (2003-2007)
20. Organizing Committee Chair, International Computer Symposium, Taiwan (2002)
21. Director, Power Electronics Association, Taiwan (2001-2007)

Important Academic Contributions

Academic Achievements

Prof. Lin's contributions are well recognized by the intelligent control and renewable energies communities; he is a pioneering researcher in his discipline. According to the databases of IEEE Xplore and Thomson Reuters ISI Web of Science, he is the pioneer to apply fuzzy neural network on real-time control of the servo motor drive, which can increase the control precision of the motor servo drives. Therefore, IEEE Systems, Man, & Cybernetics (SMC) Magazine invited Prof. Lin to publish his contribution in an invited article "Online Autotuning of a Servo Drive Using Wavelet Fuzzy Neural Network to Search for the Optimal Bandwidth" in its Oct. 2018 issue. Moreover, he has very distinguished contribution in the development of intelligent control technologies of microgrid and smart grids and renewable energy resources, which can increase

the penetration rate of renewable energy resources. Owing to his contributions on the intelligent control of microgrid, the following two articles: “Increasing the Penetration Rate of Renewable Energy Resources by Intelligent Controlled Microgrid” and “Intelligent Control of Grid-Connected Microgrid with Virtual Inertia” have been published by Taiwan Research Highlight, Engineering & Technologies, in 2020 and 2021, respectively.

According to the databases of IEEE Xplore and Thomson Reuters ISI Web of Science, he is the pioneer to apply fuzzy neural network on real-time control of PV power plant and microgrid. Listed below are evidence of the impact of Prof. Lin’s work: his H-index of 48 in Web of Science reflects over 7794 citations (Lin, Faa-Jeng) (Nov. 2023); his H-index of 63 in Google Scholar reflects more than 12732 citations (Nov. 2023). In addition, in the “World's Top 2% Scientists 2020”, which was released by Stanford University recently by using Scopus publication impact scores (https://elsevier.digitalcommonsdata.com/datasets/btchxktzyw/3?fbclid=IwAR3hwMId0tq0xhZPCGwiXtLEdwuvn7TToIafNeLgF8ezaRT9lQ__svOHvc4), his total ranking is 16,699 among nearly 8 million scholars (Lin, Faa Jeng); his ranking in the subfield of Electrical & Electronic Engineering is 41 among all 105,029 scholars worldwide. He is literally a highly cited scholar in his expertise field. Furthermore, In the “World's Top 2% Scientists 2022” (https://elsevier.digitalcommonsdata.com/datasets/btchxktzyw/6), his ranking in the subfield of Electrical & Electronic Engineering is 46/111,935. Additionally, the total research budget of him from MOST is more than $2.5 million USD for the past 7 years (2017-2023).

Prof. Lin’s contributions are well recognized by the power and control engineering communities. He has received the Outstanding Research Award from National Science Council (NSC) in 2004, 2010 and 2013. This award is one of the highest honors bestowed in academia of Taiwan, indicating that he is a pioneering scholar in the intelligent systems and control areas. He also received the Outstanding Electrical Engineering Professor Award from the Chinese Institute of Electrical Engineering in 2005 for his contributions to research and education in his discipline. Moreover, he has received Outstanding Automatic Control Engineering Award from Chinese Automatic Control Society in 2011; the Outstanding Professor of Engineering Award, the Chinese Institute of Engineers, Taiwan, 2016; Chair Professor Award from National Central University in 2010, 2013, 2016, 2019 and 2012; Honorary Chair Professor Award from National Chin-Yi University of Technology in 2019; Outstanding Research Fellow Award, MOST, Taiwan, 2021. Furthermore, he is a Fellow of the Institution of Engineering and Technology (IET, former IEE) since 2007. In addition, owing to his contributions to intelligent control systems for motor drives and motion control, he has been elevated to Fellow by the IEEE in 2017.

Prof. Lin’s career is dedicated to the development of intelligent AC servo drive

systems, and intelligent control techniques for smart grid and renewable energy resources for more than 30 years. He has a good reputation in this research field both in the national and international communities. His contributions to the development of smart grid technologies and industries in Taiwan are well recognized. Therefore, he has received the 29th TECO Award, 2022, in the field of Mechanical Engineering/Energy/Environmental Technology, and Outstanding Contribution Award of Power Electronics, Taiwan Power Electronics Association, 2023.

Industrial Cooperation

Prof. Lin is also served as a consultant for industries in Taiwan and has transferred many technologies to several companies in Taiwan. For instance, PV and battery energy storage system management system for microgrid has been transferred to NextDrive Inc., Taiwan, in 2019; intelligent parameters identification and gain autotuning technologies have been transferred to Racing Electric Instrument Inc., Taiwan, and Delta Electronics Inc., Taiwan, for new type of servo motor drives in 2018 and 2021, respectively; Sensorless control of synchronous motor drive using high-frequency signal injection technology has been transferred to Myson Century Inc. in 2013; active filter algorithm for microgrid has been transferred to Chung-Hsin Electric Machinery Mfg. Inc. in 2017; low voltage ride through technology for the grid connected PV power plant has been transferred to Controlnet International Inc. also in 2017. In addition, through the project "Research of Power Regulation and Field Implementation for Smart Multi-level Microgrid" of MOST in 2021, the technologies of energy management system of micorgrid have been transferred to NextDrive Inc. and Taiwan Cement Company (TCC). These two companies will develop their technologies and products, such as aggregator and grid-connected battery energy storage system, to join the ancillary service of Taiwan Power Company. The scale of the business has been estimated to be a few billion NTD per year. In addition, the total payment from the private companies for the technologies transferring of him is over $0.3 million USD for the past 7 years (2017-2023). His contributions have high impact to the smart grid and renewable energy industries in Taiwan.

Academic Services

Prof. Lin was the principle investigator (PI) of the National Energy Project (NEP) "Energy Research Collaboration between Taiwan's top universities and elite research centers and The California Institute of Technology (CALTECH)" from 2012 to 2014. The total research budget is $5.2 million USD for three years. Under the support of this program, CALTECH and Taiwan's top universities and elite research centers jointly supported faculty members to carry out research projects on relevant topics of energy technologies such as fuel cells, solar PV, thermoelectric, CO2 capture and conversion, biofuels and smart grid. One of the

CALTECH participants Dr. Frances Arnold has won the 2018 Nobel Prize in Chemistry for "the directed evolution of enzymes," according to the award citation. Parts of her contributions were supported by this project. Moreover, her counterparts in Academia Sinica, Taiwan, are still using the directed evolution of enzymes in their laboratory for the development of biofuel technologies.

He was the chair and principle investigator for Smart Grid Focus Center Project, National Energy Project. This center aims to integrate Taiwan's R&D resources in smart grid and renewable energy resources to formulate overall development strategies of smart grid and supporting industries development (IEEE Smart Grid Newsletters, Aug. 2015). The total research budget was more than $52 million USD for five years (2014~2018), and all major research institutes, universities and private companies in the field of smart grid have joined this project. More than thirty major power facilities companies such as Tatung and Delta have invested tens of millions USD in this project. Under his leadership, the revenues from technology transfer are over $5.6 million USD including smart metering interface, in home display, energy saving adapter, digital protective relay, energy management systems and micro-grid control system. Intelligent systems have also been developed in this project for the converter control of renewable energy resources, modeling and optimization of smart grid, and forecasting of wind and solar power.

Research projects

In the past three decades, he has produced great research results in the areas of intelligent control theory applications, motor drive and control, renewable energy resources control and microgrid. His results have been particularly distinguished in the areas of advanced intelligent control of AC linear motor servo drives and intelligent control of renewable energy resources. According to the journal paper information of IEEE and IET from IEEE Xplore, he has made great contributions in the theoretical innovations and technological developments for above two research areas, and occupies a globally leading role in these fields. The most important five research achievements in recent five years are listed below:

- **Intelligent Control Technologies of Smart Grid and Renewable Energy Resources**

The development of operation and intelligent control technologies of smart grid and renewable energy resources includes active islanding detection, control of battery energy storage system, control of three-phase squirrel-cage induction generator (IG), low-voltage ride through (LVRT) control of photovoltaic (PV) system for weak grid condition. Some intelligent controlled three-phase squirrel-cage IGs have been proposed for stand-alone power applications through ac–dc and dc–ac power converters. The electric frequency of the IG is controlled using the indirect field-oriented control mechanism. Moreover, radial basis function network (RBFN), recurrent fuzzy neural network (RFNN) and Elman neural network (ENN) have been introduced as the regulating controllers for both the dc-link voltage and the ac line

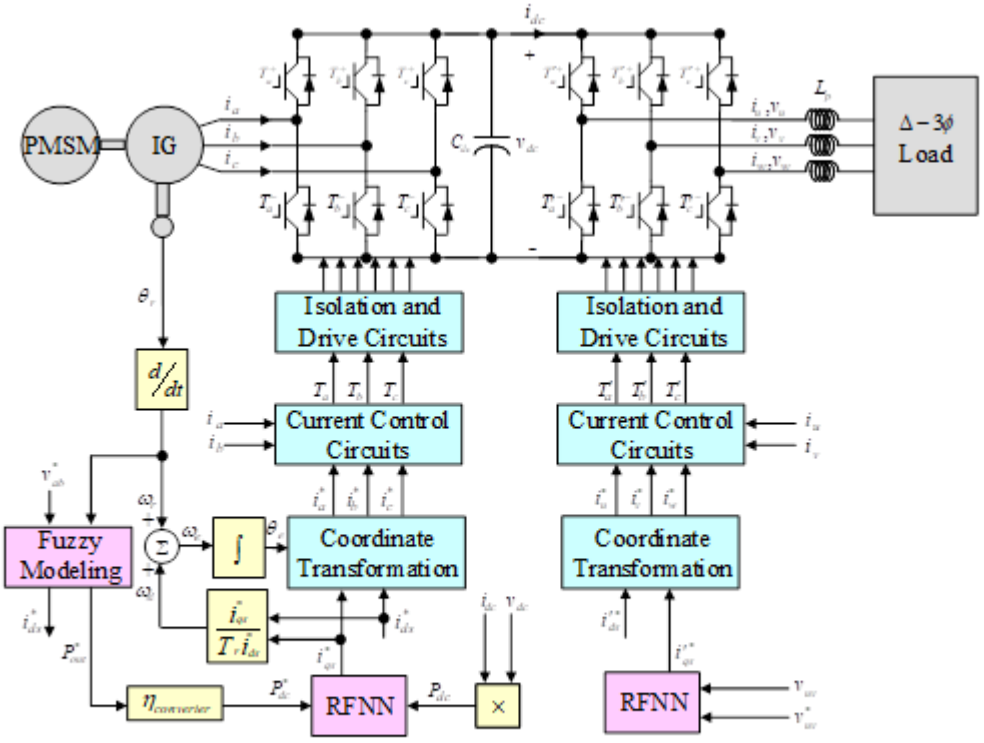
voltage of the dc–ac power inverter. Furthermore, the on-line training algorithm based on backpropagation was derived to train the connective weights, means and standard deviations in real time. In addition, an Improved Particle Swarm Optimization (IPSO) algorithm was adopted to adjust the learning rates in the backpropagation process in order to further improve the on-line learning ability and the control performance. The most important publications of recent five years are listed below:

[1] F. J. Lin, K. H. Tan, Yu-Kai Lai, and Wen-Chou Luo, "Intelligent PV system with unbalanced current compensation using CFNN with AMF," *IEEE Trans. Power Electronics*, vol. 34, no. 9, pp. 8588-8598, 2019.

[2] F. J. Lin, K. H. Tan, W. C. Luo, and G. D. Xiao, "Improved LVRT Performance of PV Power Plant Using Recurrent Wavelet Fuzzy Neural Network Control for Weak Grid Condition," *IEEE Access*, vol. 8, pp. 69346-69358, 2020.

[3] F. J. Lin, C. I. Chen, G. D. Xiao, and P. R. Chen, "Voltage Stabilization Control for Microgrid with Asymmetric Membership Function Based Wavelet Petri Fuzzy Neural Network," IEEE Trans. Smart Grid, vol. 12, no. 5, pp. 3731-3741, 2021. (Increasing the Penetration Rate of Renewable Energy Resources by Intelligent Controlled Microgrid, Taiwan Research Highlight, Engineering & Technologies, Nov. 16, 2021)

[4] F. J. Lin, J. C. Liao, Y. M. Zhang, and Y. C. Huang, "Optimal Economic Dispatch and Power Generation for Microgrid Using Lagrange Multipliers-based Method with HIL Verification," IEEE Systems Journal, vol. 17, no. 3, pp. 4533-4544, 2023.



Control block of induction generator system with RFNN control

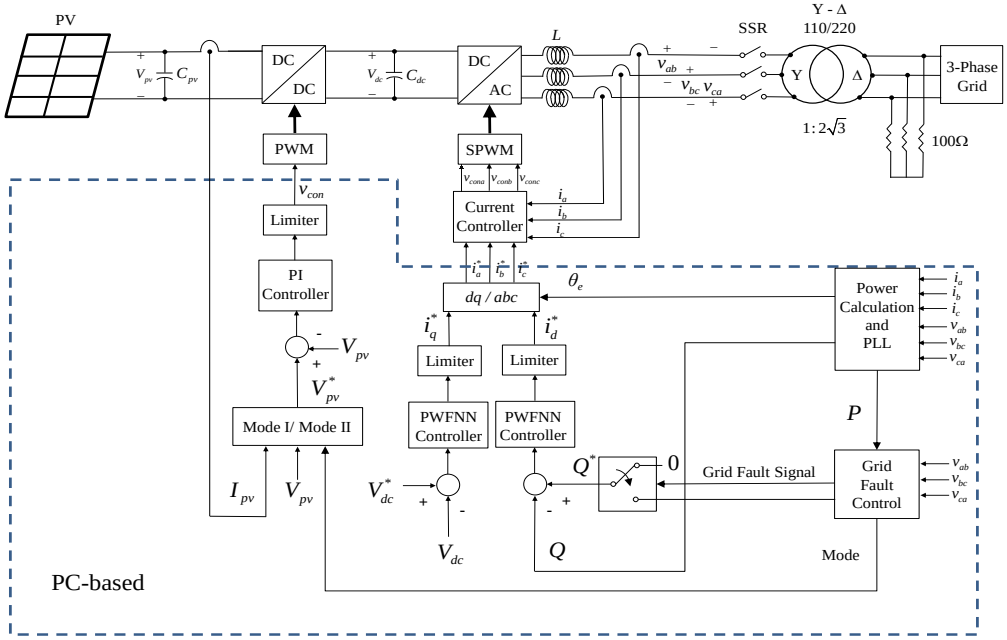
● Intelligent Power Control System of Three-Phase Grid-Connected PV System

An intelligent controller based on probabilistic wavelet fuzzy neural network (PWFNN) has been developed for the reactive and active power control of a three-phase grid-connected photovoltaic (PV) system during grid faults. The inverter of the three-phase grid-connected PV system should provide a proper ratio of reactive power to meet the low-voltage ride through (LVRT) regulations and control the output current without exceeding the maximum current limit simultaneously during grid faults. Therefore, the proposed intelligent controller regulates the value of reactive power to a new reference value, which complies with the regulations of LVRT under grid faults. Moreover, a dual-mode operation control method of the converter and inverter of the three-phase grid connected PV system is designed to eliminate the fluctuation of dc-link bus voltage under grid faults. An intelligent controller based on the Takagi–Sugeno–Kang-type probabilistic fuzzy neural network with an asymmetric membership function (TSKPFNN-AMF) was also developed in this study for the reactive and active power control of a three-phase grid-connected PV system during grid faults. The most important publications of recent five years are listed below:

[5] F. J. Lin, K. C. Lu, T. H. Ke, and H. Y. Li, "Reactive Power Control of Three-Phase PV System during Grids Faults Using Takagi-Sugeno-Kang Probabilistic Fuzzy Neural Network Control," *IEEE Trans. Industrial Electronics*, vol. 62, no. 9, pp. 5516-5528, 2015. (SCI)

[6] F. J. Lin, K. C. Lu, and B. H. Yang, "Recurrent Fuzzy Cerebellar Model Articulation Neural Network Based Power Control of Single-Stage Three-Phase Grid-Connected Photovoltaic System during Grid Faults," *IEEE Trans. Industrial Electronics*, vol. 64, no. 2, pp. 1258-1268, 2017.

[7] K. C. Lu, F. J. Lin, and B. H. Yang, "Profit Optimization Based Power Compensation Control Strategy for Grid-Connected PV System," *IEEE Systems Journal*, vol. 12, no. 3, pp. 2878-2881, 2018.



Intelligent control of PV system using PWFNN with LVRT under grid fault

● **Intelligent Speed Controller with Optimal Bandwidth for PMSM Drive System**

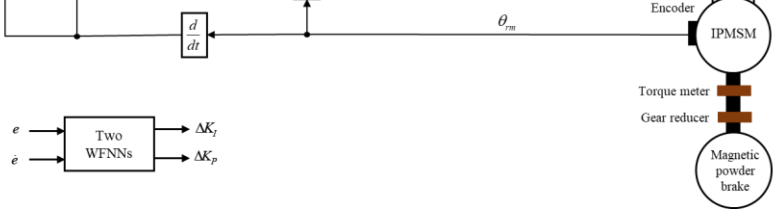
A novel maximum torque per ampere (MTPA) method based on power perturbation for a field-oriented control (FOC) interior permanent magnet synchronous motor (IPMSM) drive system is proposed in this study. The proposed MTPA method, which is parameter independent and can improve the motor operation at both start-up and low speed, is designed based on the power perturbation by using the signal injection in the current angle. Moreover, the influence of current and voltage harmonics to the MTPA control can be eliminated effectively. Furthermore, to enhance the robustness of the control system, an online tuning scheme for an integral-proportional controller using a new wavelet fuzzy neural network (WFNN) with disturbance torque feedforward control is developed where the disturbance torque is obtained from an improved disturbance torque observer. In addition, in order to achieve an optimal bandwidth, a novel online auto-tuning technique using a two-input two-output WFNN for a FOC IPMSM drive is also proposed in this study. The most important publications of recent five years are listed below:

[8] F. J. Lin, Y. T. Liu, and W. A. Yu, "Power Perturbation Based MTPA with Intelligent Speed Controller for IPMSM Drive System," *IEEE Trans. Industrial Electronics*, vol. 65, no. 5, pp. 3677-3687, 2018.

[9] F. J. Lin, S. G. Chen, Y. T. Liu, and W. A. Yu, "Online Autotuning of a Servo Drive Using Wavelet Fuzzy Neural Network to Search for the Optimal Bandwidth," *IEEE SMC Magazine*, Oct., pp. 28-37, 2018.

[10] F. J. Lin, S. G. Chen, S. Li, H. T. Chou, and J. R. Lin, "Online Auto-Tuning Technique for IPMSM Servo Drive by Intelligent Identification of Moment of Inertia," *IEEE Trans. Industrial Informatics*, vol. 16, no. 12, pp. 7579-7590, 2020.

[11] F. J. Lin, P. L. Wang, and I. M. Hsu, "Intelligent Nonsingular Terminal Sliding Mode Controlled Nonlinear Time-Varying System Using RPPFNN-AMF," IEEE Trans. Fuzzy Systems, Early Accessed, 2023.



Block diagram of intelligent IPMSM servo drive system with optimal bandwidth

● **High-performance Synchronous Reluctance Motor Drive System Using Intelligent Control**

The purpose of this research is to develop a high-performance synchronous reluctance motor (SynRM) drive system and its control methods. Since the SynRM does not require the rare earth permanent magnet, it can possess both the characteristics of high efficiency and performance. Moreover, the digital signal processor (DSP)-based position and speed controllers are developed to control the high-performance SynRM drive system. The core of the hardware processor is a Texas Instruments TMS320F28075 DSP, and the proposed control methods are realized in the DSP using the "C" language. Furthermore, the rotor position and speed of SynRM are measured by using an encoder via peripheral expansion circuit board and quadrature encoder pulse (QEP) interface, and the phase current signals are obtained by using the hall current sensors and via the analog to digital converter (ADC). Finally, a SynRM drive system using the field-oriented control (FOC) is achieved. In terms of controller design, the developed intelligent backstepping control (IBSC), adaptive computed current (ACC) speed control, recurrent feature selection fuzzy neural network (RFSFNN) and recurrent Legendre fuzzy neural network (RLFNN) are adopted to improve the speed and position control performance of SynRM and to achieve the maximum torque per ampere (MTPA) control for minimizing the stator copper loss. The most important publications of recent five years are listed below:

[12] F. J. Lin, S. G. Chen, and C. W. Hsu, "Intelligent Backstepping Control Using Recurrent Feature Selection Fuzzy Neural Network for Synchronous Reluctance Motor Position Servo Drive System," *IEEE Trans. Fuzzy Systems*, vol. 27, no. 3, pp. 413-427, 2019.

[13] F. J. Lin, M. S. Huang, S. G. Chen, and C. W. Hsu, "Intelligent Maximum Torque per Ampere Tracking Control of Synchronous Reluctance Motor Using Recurrent Legendre Fuzzy Neural Network," *IEEE Trans. Power Electronics*, vol. 34, no. 12, pp. 12080-12093, 2019.

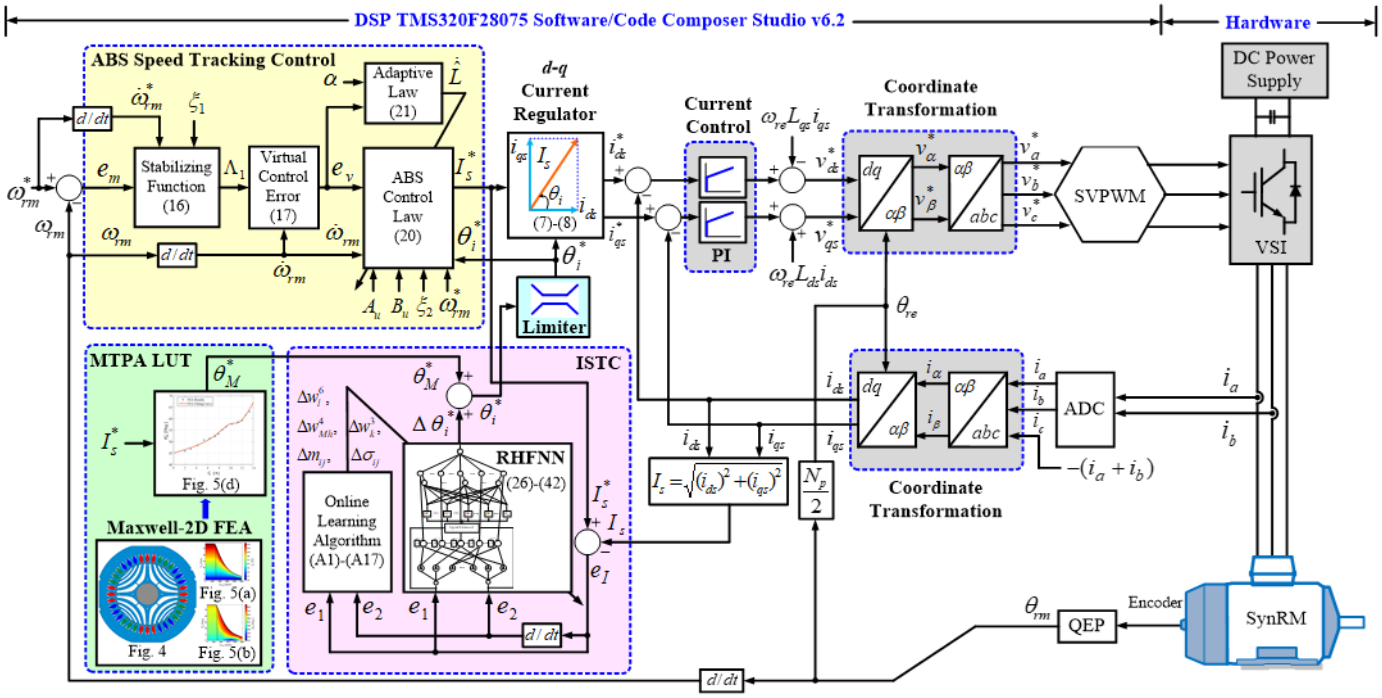
[14] F. J. Lin, M. S. Huang, S. G. Chen, C. W. Hsu, and C. H. Liang "Adaptive Backstepping Control for Synchronous Reluctance Motor Based on Intelligent Current Angle Control," *IEEE Trans. Power Electronics*, vol. 35, no. 7, pp. 7465–7479, 2020.

[15] S. G. Chen, F. J. Lin, C. H. Liang, and C. H. Liao, "Intelligent Maximum Power Factor Searching Control Using Recurrent Chebyshev Fuzzy Neural Network Current Angle Controller for SynRM Drive System," *IEEE Trans. Power Electronics*, vol. 36, no. 3, pp. 3496-3511, 2021.

[16] F. J. Lin, S. G. Chen, M. S. Huang, C. H. Liang, and C. H. Liao, "Adaptive Complementary Sliding Mode Control for Synchronous Reluctance Motor Based on Direct-Axis Current Control," *IEEE Trans. Industrial Electronics*, vol. 69, no. 1, pp.

141-150, 2022.

[17] S. G. Chen, F. J. Lin, M. S. Huang, S. P. Yeh and T. S. Sun, "Proximate Maximum Efficiency Control for Synchronous Reluctance Motor via MRCT and MTPA Control," IEEE/ASME Trans. Mechatronics, vol. 28, no. 3, pp. 1404 -1414, 2023.



High-performance Synchronous Reluctance Motor Drive System Using Intelligent Control

- **Intelligent Control of Grid-Connected Microgrid with Virtual Inertia**

A microgrid with virtual inertia using master–slave control is proposed in this article to overcome the drawbacks of traditional inverter-based distributed generators for lack of inertia and without grid-forming capability. The microgrid using master–slave control is composed of a storage system, a photovoltaic (PV) system and a varying resistive three-phase load. The storage system and PV system are regarded as the master unit and the slave unit, respectively, in the microgrid. Moreover, in order to improve the reactive power control in grid-connected mode and the transient response of microgrid during the switching between the gridconnected mode and islanding mode, an online trained recurrent probabilistic wavelet fuzzy neural network (RPWFNN) is proposed to replace the conventional proportional-integral (PI) controller in the storage system. Furthermore, when the microgrid is operated in islanding mode, the load variation will have serious influence on the voltage control of the microgrid. Thus, the RPWFNN control is also proposed to improve the transient and steady-state responses of voltage control in the microgrid. The most important publications of recent five years are listed below:

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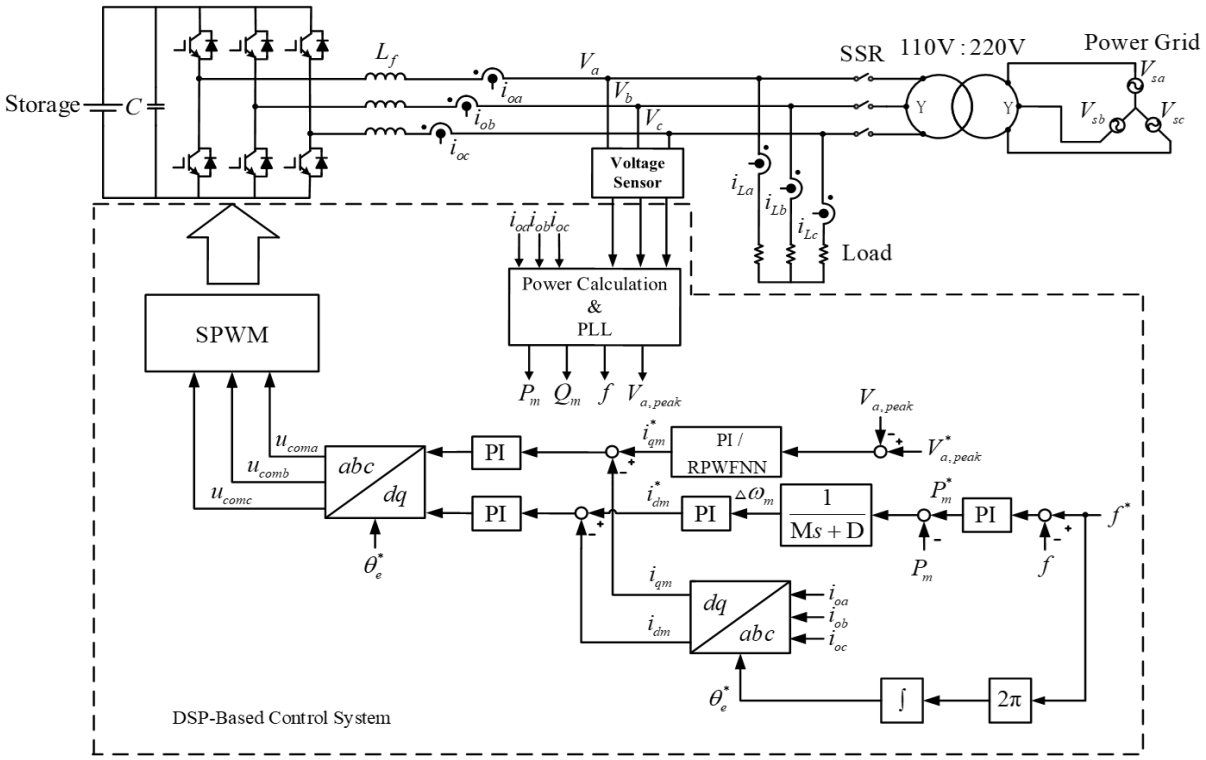

Control Block of Intelligent Control of Grid-Connected Microgrid with Virtual Inertia

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