Feng-Lei Fan

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EDUCATION

- Rensselaer Polytechnic Institute, US, PhD, 2017-Now, Biomed. Eng.
- National Chiao-Tung University, Taiwan, Exchange Student, 2015, Opt. Eng.
- Harbin Institute of Technology, China, BE, 2013-2017, Opt. Eng.

EMPLOYMENT

- Sep 2017-Now, *Research Assistant*, (Advisor: Wang, Ge, AAAS&NAI&IEEE Fellow), Department of Biomedical Engineering, **Rensselaer Polytechnic Institute,** Troy, NY, US.
  ✓ Conducted research of advanced neural networks and their interpretation.
- Jan 2020-Aug 2020, *Intern*, (Mentor: Krotov, Dimitry), **MIT-IBM Watson AI Lab,** Cambridge, MA, US.
  ✓ Developed an unsupervised meta-learning algorithm for graph embedding.
- Summer 2019, *Summer Intern*, (Mentor: Ahn, Sangtae), **GE Global Research Center,** Niskayuna, NY, US.
  ✓ Developed deep learning-based model observer for PET image lesion detection.
- Summer, 2016, *Summer Intern*, (Supervisor: Nunzi, JM, Canada Research Chair), Department of Physics, **Queen's University**, Kingston, Ontario, Canada.
  ✓ Studied localized plasmon and MIE theory.
- Jan 2015-June 2015, *Research Intern*, (Supervisor: Weng, Chi-Wen, Department Head), Department of Applied Mathematics, **National Chiao-Tung University**, Hsinchu, ROC (Taiwan).
  ✓ Studied spectral characterization of bipartite graphs.

HONORS

- **2019, IBM AI Horizon Fellowship,** Rensselaer Polytechnic Institute (Fellowship covers tuition and living expenses until the end of PhD)
- **2016, Congxin Scholarship,** Harbin Institute of Technology (Awarded to only two undergraduates annually at the university)
- **2015, People's scholarship,** Harbin Institute of Technology
- **2014, FujiXerox Scholarship,** Harbin Institute of Technology (Awarded to Top 5% annually)

RESEARCH INTERESTS

- Biomedical imaging problems, Deep learning theory, Applied Mathematics.

PUBLICATIONS

I. Quadratic Neuron

- Systematic studies to demonstrate the advantages of quadratic neurons over conventional neurons in terms of capacity, interpretability, and compactness.

a. **Fan FL**, Cong W, and Wang G: A new type of neurons for machine learning. *Int. J. for Number. Method. in Biomed. Eng.*, 34.2 (2018): e2920.

b. **Fan F**, Cong W, & Wang G: Generalized backpropagation algorithm for training second-order neural networks. *Int. J. for Number. Method. in Biomed. Eng.* 34.5, (2018) e2956.

c. **Fan FL**, Wang G. Fuzzy logic interpretation of quadratic networks. *Neurocomputing*, 2019 Sep 20.

d. **Fan FL**, Xiong J, & Wang, G. (2020). Universal approximation with quadratic deep networks. *Neural Networks*, 124, 383-392.

e. **Fan FL**, Shan H... & Wang G. (2019). Quadratic Autoencoder (Q-AE) for Low-dose CT Denoising. *IEEE Transactions on Medical Imaging*, 2019 Dec 31;39(6):2035-50.

II. Interpretability & Theory Research

- Studies to draw insights from signal processing, representation, and generalization theory to enhance the understanding of deep networks and further guide the network design.

f. **Fan FL**, Li M, Teng Y, Wang G. Soft-Autoencoder and Its Wavelet Adaptation Interpretation. *IEEE Transactions on Computational Imaging*, 6, 1245-1257.

g. **Fan FL**, Xiong J, & Wang, G. (2020). On Interpretability of Artificial Neural Networks. arXiv preprint arXiv:2001.02522.

h. **Fan FL** & Wang G. (2020). Duality of Width and Depth of Neural Networks. arXiv preprint arXiv:2002.02515.

i. **Fan FL**, Wang D, Guo H, Zhu Q, Yan P, Wang G and Yu H. Universal approximation by a slim network with sparse shortcut connections. arXiv preprint arXiv:1811.09003. 2018 Nov 22.

j. **Fan FL**, Wang G. Learning from Pseudo-Randomness with an Artificial Neural Network–Does God Play Pseudo-Dice? *IEEE Access*, (2018), 6: 22987-22992.

III. Algebraic Graph Theory

- As an undergraduate exchange student, supervised by Prof. Chi-Wen Weng, I participated in two inequality estimation problems involving regular graphs and bipartite graphs, which have the potential of being used in complex networks.

k. **Fan FL**, Weng C: A characterization of strongly regular graphs in terms of the largest signless Laplacian eigenvalues. *Linear Algebra and its Applications*, (2016), 506: 1-5.

l. Cheng Y J, **Fan FL**, Weng C (alphabetical order): An extending result on spectral radius of bipartite graphs. *Taiwanese Journal of Mathematics*, (2018), 22(2): 263-274.

OUTREACH

I. Operating a STEM Blog on WeChat

- I lead a team of graduate students and post-docs from Peking University, California Institute of Technology, Vanderbilt University, National University of Singapore, etc. to operate a WeChat Blog named “Authentic Scholars Create Miracles” to popularize science and knowledge to undergraduates and graduates with an emphasis on artificial intelligence theory and applications. Up to now, we have published 100 original articles, attracted 5,000 followers, and recorded over 60,000 full-text views.

II. Service as a Reviewer

- I serve as a frequent reviewer for *IEEE Access, International Journal of Numerical Methods in Biomedical Engineering, IEEE Transactions on Medical Imaging, IEEE Transactions on Neural Networks and Learning System, Computerized Medical Imaging and Graphics, IEEE Transactions on Fuzzy Systems, PLoS ONE.*
- In the past four years, I have reviewed 12 papers.

III. Talks at the Meetings & Workshops

- Poster presentation at fully3D 2019, Philadelphia, PA, in June 2019.
- Poster presentation at Graduate Symposium of Department of Biomedical Engineering, RPI, in Jan, 2019.
- Speaker for the Deep Recon Workshop 2017, RPI (the 1st deep learning based tomographic reconstruction conference in the world).
- Invited Student Speaker at ICIPTMA 2017 (International Conference on Image Processing: Theory, Method and Applications), Harbin, China (only two students were selected from the university to make oral presentation).