Shijun ZHANG

Phillip Griffiths Assistant Research Professor

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Appointments

Phillip Griffiths Assistant Research Professor,
Duke University, United States — Aug 2022 ∼ Present
Mentors: **Jianfeng Lu** and **Hongkai Zhao**

Research Fellow, National University of Singapore, Singapore — Jan 2021 ∼ Jul 2022
Mentor: **Zuowei Shen**

Education

Ph.D. in Mathematics, National University of Singapore, Singapore — Aug 2016 ∼ Jan 2021
Thesis: *Deep neural network approximation via function compositions* [URL]
Supervisors: **Zuowei Shen** and **Haizhao Yang**

B.S. in Mathematics, Wuhan University, China — Sep 2012 ∼ Jul 2016
Thesis supervisor: **Xiliang Lv**

Awards

Scholar Award, NeurIPS 2022 Financial Assistance Program, URL.

The EASIAM (East Asia section of SIAM) Student Paper Prize, 2020 ∼ 2021, first prize, URL.

Publications

[number] (Position & Institution, Date of first submission) Author(s). *Paper title.* Journal or conference reference. [Links]

* Corresponding author

RF = Research Fellow NUS = National University of Singapore ARP = Assistant Research Professor Duke = Duke University

Preprints

[12] (ARP at Duke, 29 Jun 2023) **Shijun Zhang**, Hongkai Zhao, Yimin Zhong, Haomin Zhou. *Why shallow networks struggle with approximating and learning high frequency: A numerical study.* Submitted. [arXiv]

Published (Accepted)

[11] (ARP at Duke, 13 Jul 2023) **Shijun Zhang***, Jianfeng Lu, Hongkai Zhao. *Deep network approximation: Beyond ReLU to diverse activation functions.* Accepted by **Journal of Machine Learning Research**. [arXiv]

[10] (ARP at Duke, 29 Jan 2023) **Shijun Zhang***, Jianfeng Lu, Hongkai Zhao. *On enhancing expressive power via compositions of single fixed-size ReLU network.* Proceedings of the 40th International Conference on Machine Learning (**ICML 2023**), PMLR 202:41452–41487, 2023. [arXiv, Poster, Conference]

[9] (RF at NUS, 19 May 2022) Zuowei Shen, Haizhao Yang, **Shijun Zhang***. *Neural network architecture beyond width and depth.* Advances in Neural Information Processing Systems (**NeurIPS 2022**), 35:5669–5681, 2022. [arXiv, Poster, Conference]

[8] (RF at NUS, 15 Nov 2021) Zuowei Shen, Haizhao Yang, **Shijun Zhang***. *Deep network approximation in terms of intrinsic parameters.* Proceedings of the 39th International Conference on Machine Learning (**ICML 2022**), PMLR 162:19909–19934, 2022. [arXiv, Spotlight, Conference]

[7] (RF at NUS, 6 Jul 2021) Zuowei Shen, Haizhao Yang, **Shijun Zhang***. *Deep network approximation: achieving arbitrary accuracy with fixed number of neurons.* **Journal of Machine Learning Research**, Volume 23, Issue 276, September 2022, Pages 1–60. [arXiv, Journal]

[6] (RF at NUS, 28 Feb 2021) Zuowei Shen, Haizhao Yang, **Shijun Zhang***. *Optimal approximation rate of ReLU networks in terms of width and depth.* **Journal de Mathématiques Pures et Appliquées**, Volume 157, January 2022, Pages 101–135. [arXiv, Journal]

[5] (PhD at NUS, 25 Oct 2020) Zuowei Shen, Haizhao Yang, **Shijun Zhang**. *Neural network approximation: Three hidden layers are enough.* **Neural Networks**, Volume 141, September 2021, Pages 160–173. [arXiv, Journal]

[4] (PhD at NUS, 22 Jun 2020) Zuowei Shen, Haizhao Yang, **Shijun Zhang**. *Deep network with approximation error being reciprocal of width to power of square root of depth.* **Neural Computation**, Volume 33, Issue 4, April 2021, Pages 1005–1036. [arXiv, Journal]

[3] (PhD at NUS, 9 Jan 2020) Jianfeng Lu, Zuowei Shen, Haizhao Yang, **Shijun Zhang**. *Deep network approximation for smooth functions.* **SIAM Journal on Mathematical Analysis**, Volume 53, Issue 5, September 2021, Pages 5465–5506. [arXiv, Journal]

[2] (PhD at NUS, 13 Jun 2019) Zuowei Shen, Haizhao Yang, **Shijun Zhang**. *Deep network approximation characterized by number of nuerons.* **Communications in Computational Physics**, Volume 28, Issue 5, November 2020, Pages 1768–1811. [arXiv, Journal]

[1] (PhD at NUS, 26 Feb 2019) Zuowei Shen, Haizhao Yang, **Shijun Zhang**. *Nonlinear approximation via compositions.* **Neural Networks**, Volume 119, November 2019, Pages 74–84. [arXiv, Journal]

Shijun Zhang 张仕俊

Assistant Research Professor,
Duke University

Neural network
Approximation theory

	All	Since 2019
Citations	672	671
h-index	8	8
i10-index	8	8

0 articles — not available

7 articles — available

Based on funding mandates

TITLE	CITED BY	YEAR
Deep network approximation for smooth functions J Lu, Z Shen, H Yang, S Zhang SIAM Journal on Mathematical Analysis 53 (5), 5465–5506	194	2020
Deep network approximation characterized by number of neurons Z Shen, H Yang, S Zhang Communications in Computational Physics 28 (5), 1768-1811	161	2020
Neural network approximation: Three hidden layers are enough Z Shen, H Yang, S Zhang Neural Networks 141, 160-173	82	2021
Nonlinear approximation via compositions Z Shen, H Yang, S Zhang Neural Networks 119, 74-84	77	2019
Optimal approximation rate of ReLU networks in terms of width and depth Z Shen, H Yang, S Zhang Journal de Mathématiques Pures et Appliquées 157, 101-135	67	2022
Deep network with approximation error being reciprocal of width to power of square root of depth Z Shen, H Yang, S Zhang Neural Computation 33 (4), 1005-1036	52	2021
Deep network approximation: Achieving arbitrary accuracy with fixed number of neurons Z Shen, H Yang, S Zhang The Journal of Machine Learning Research 23 (276), 1-60	16	2022
Deep neural network approximation via function compositions S Zhang PhD thesis, National University of Singapore	10 *	2020
Neural Network Architecture Beyond Width and Depth S Zhang, Z Shen, H Yang Advances in Neural Information Processing Systems 35, 5669-5681	7	2022
Deep network approximation in terms of intrinsic parameters Z Shen, H Yang, S Zhang International Conference on Machine Learning 162, 19909-19934	4	2022
Deep Network Approximation: Beyond ReLU to Diverse Activation Functions S Zhang, J Lu, H Zhao arXiv preprint arXiv:2307.06555	2	2023
Why Shallow Networks Struggle with Approximating and Learning High Frequency: A Numerical Study S Zhang, H Zhao, Y Zhong, H Zhou arXiv preprint arXiv:2306.17301		2023
On Enhancing Expressive Power via Compositions of Single Fixed-Size ReLU Network S Zhang, J Lu, H Zhao arXiv preprint arXiv:2301.12353		2023