Shijun ZHANG

Assistant Professor

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ORCID:	URL	Address: Departmen	nt of Applied Mathematics
Articles on arXiv:	URL	The Hong Ko	ong Polytechnic University
Appointments			
Assistant Professor (Te The Hong Kong Polytech	enure-Track), nic University ((PolyU), Hong Kong SAR, Ch	ina Jul 2024 ~ Present
Phillip Griffiths Assist Duke University, United S Mentors: Jianfeng Lu as	ant Research States ad Hongkai Z	Professor, hao	Aug 2022 \sim Jun 2024
Research Fellow, Nation Mentor: Zuowei Shen	nal University o	of Singapore, Singapore	Jan 2021 \sim Jul 2022
Education			
Ph.D. in Mathematics Thesis: <i>Deep neural networ</i> Supervisors: Zuowei She	, National Univ k approximation en and Haizha	versity of Singapore, Singapore via function compositions [PDF o Yang	e Aug 2016 \sim Jan 2021 , URL]
B.S. in Mathematics , ^N Thesis supervisor: Xilian	Wuhan Universi g Lv	ity, China	Sep 2012 \sim Jun 2016
Teaching			
Mathematical Numeri Instructor, Syllabus	cal Analysis (Math 361S), Duke University	Spring 2024
Matrices and Vectors Teaching assistant	(Math 218D-2),	, Duke University	Fall 2023

Awards

Scholar Award, NeurIPS 2022 Financial Assistance Program, URL.

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

Publications

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

* Corresponding author \dagger Equal contribution

RF = Research Fellow NUS = National University of Singapore ARP = Assistant Research Professor Duke = Duke University AP = Assistant Professor (Tenure-Track) PolyU = The Hong Kong Polytechnic University

Preprint(s)

- [14] (AP at PolyU, 12 Jul 2024) Qianchao Wang[†], Shijun Zhang[†], Dong Zeng, Zhaoheng Xie, Hengtao Guo, Feng-Lei Fan, Tieyong Zeng. Don't Fear Peculiar Activation Functions: EUAF and Beyond. Submitted. [arXiv]
- [13] (ARP at Duke, 30 Jun 2024) Shijun Zhang*, Hongkai Zhao, Yimin Zhong, Haomin Zhou. Structured and Balanced Multi-component and Multi-layer Neural Networks. Submitted. [arXiv]
- [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. Journal of Machine Learning Research, 25(35):1–39, 2024. [arXiv, Journal]
- [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]
- (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 Professor, PolyU Approximation theory Neural networks

	All	Since 2019
Citations	931	928
h-index	10	10
i10-index	10	10

0 articles 8 articles

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	266	2020
Deep network approximation characterized by number of neurons Z Shen, H Yang, S Zhang Communications in Computational Physics 28 (5), 1768-1811	199	2020
Neural network approximation: Three hidden layers are enough Z Shen, H Yang, S Zhang Neural Networks 141, 160-173	110	2021
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	107	2022
Nonlinear approximation via compositions Z Shen, H Yang, S Zhang Neural Networks 119, 74-84	97	2019
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	61	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	30	2022
Deep network approximation for smooth functions. arXiv e-prints J Lu, Z Shen, H Yang, S Zhang arXiv preprint arXiv:2001.03040	19	2020
Neural network architecture beyond width and depth S Zhang, Z Shen, H Yang Advances in Neural Information Processing Systems 35, 5669-5681	13	2022
Deep neural network approximation via function compositions S Zhang PhD thesis, National University of Singapore	11	2020
Deep network approximation: Beyond relu to diverse activation functions S Zhang, J Lu, H Zhao Journal of Machine Learning Research 25 (35), 1-39	8	2024

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Deep network approximation in terms of intrinsic parameters Z Shen, H Yang, S Zhang International Conference on Machine Learning 162, 19909-19934	6	2022
On enhancing expressive power via compositions of single fixed-size relu network	2	2023
S Zhang, J Lu, H Zhao International Conference on Machine Learning, 41452-41487		
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	2	2023
Don't Fear Peculiar Activation Functions: EUAF and Beyond Q Wang, S Zhang, D Zeng, Z Xie, H Guo, FL Fan, T Zeng arXiv preprint arXiv:2407.09580		2024
Structured and Balanced Multi-component and Multi-layer Neural Networks S Zhang, H Zhao, Y Zhong, H Zhou arXiv preprint arXiv:2407.00765	5	2024