Hao **Zhang**

PH.D CANDIDATE

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About Me

I am now a last year Ph.D. candidate (EGD: **Mar 2025**) under the supervision of Prof. Fuhui Zhou in **College of Electronic and Information Engineering**, **Nanjing University of Aeronautics and Astronautics**. I was selected as a member of **Top-notch Postgraduate Innovative Talents Training Yinhang Project of NUAA** in 2022. I have received a Master of Engineering degree, and a Bachelor's degree from **Nanchang University**, majoring in Electrical and Communication Engineering and Internet of Things Engineering in 2020 and 2017. From Jan 1st 2024, I am now a **visiting Ph.D. student** under the supervision of Assoc Prof **Chau Yuen**'s group in the **School of Electrical & Electronic Engineering**, **Nanyang Technological University** supported by Chinese Government Scholarship from China Scholarship Council (CSC). Until now, I have published over 15 papers (Google Scholar citation: **390+**, H index: **11**), including **one ESI highly cited paper**.

Research Interests

My research interests include some sub-fields of Wireless Communication and Signal Processing in the era of Machine Learning/Deep Learning:

- **Deep Convolutional Neural Networks (DCNN)** is a class of artificial neural network with multiple layers between the input and output layers, most commonly applied to analyzing visual imagery.
- **Radio Frequency Machine Learning (RFML)** aims to apply machine learning and deep learning for a multitude of tasks in wireless communications, such as signal classification, spectrum sensing and signal identification and cognitive radio.

Education

Nanyang Technological University — *Singapore*

VISITING STUDENT. — *Jan 2024-Now*

under the supervision of Assoc Prof **Chau Yuen**'s group

Nanjing University of Aeronautics and Astronautics — *Nanjing, Jiangsu, China*

PH.D STUDENT. — *Apr. 2021-Now*

Majoring in the Information and Communication Engineering. During Jul. 2020-Mar.2021, I severed as a research assistant in NUAA.

Nanchang University — *Nanchang,Jiangxi, China*

M.ENG. IN ELECTRICAL AND COMMUNICATION ENGINEERING. — *Sep. 2017 - Jun. 2020*

- Outstanding Graduates (4%)

Nanchang University — *Nanchang,Jiangxi, China*

B.S. IN INTERNET OF THINGS ENGINEERING — *Sep. 2013 - Jun. 2017*

- Monitor of the class. "Excellent Class" title of Nanchang University (2015-2016).

Publications

1. **Hao Zhang**, Fuhui Zhou, Qihui Wu, and Naofal Al-Dhahir. "SSwsrNet: A Semi-Supervised Few-Shot Learning Framework for Wireless Signal Recognition". *IEEE Transactions on Communications*, vol. 72, no. 9, pp. 5823-5836, Sept. 2024, doi: 10.1109/TCOMM.2024.3385921.

2. **Hao Zhang**, Fuhui Zhou, Qihui Wu, Wei Wu, and Rose Qingyang Hu. "A Novel Automatic Modulation Classification Scheme Based on Multi-Scale Networks". *IEEE Transactions on Cognitive Communications and Networking*, vol. 8, no. 1, pp. 97-110, March 2022, doi: 10.1109/TCCN.2021.3091730.

3. **Hao Zhang**, Lu Yuan, Guangyu Wu, Fuhui Zhou, and Qihui Wu. "Efficient Automatic Modulation Classification Using Involution based Residual Networks". *IEEE Wireless Communication Letters*, vol. 10, no. 11, pp. 2417-2420, Nov. 2021, doi: 10.1109/LWC.2021.3102069.

4. **Hao Zhang**, Fuhui Zhou, Qihui Wu, and Chau Yuen. "FSOS-AMC: Few-Shot Open-Set Learning for Automatic Modulation Classification", *16th International Conference on Wireless Communications and Signal Processing (WCSP 2024)*, 2024.

5. **Hao Zhang**, Xianggong Hong. "Recent Progresses on Object Detection: A Brief Review". *Multimedia Tools and Applications*: 78 (19), 27809-27847. (**CCF-C**)

6. **Hao Zhang**, Xianggong Hong, Shifen Zhou and Qingcai Wang. "Infrared Image Segmentation for Photovoltaic Panels Based on Res-Unet". *In: Lin Z. et al. (eds) Pattern Recognition and Computer Vision. PRCV 2019. Lecture Notes in Computer Science, vol 11857.* Springer, Cham. (**CCF-C**)

7. **Hao Zhang**, Xianggong Hong, Li Zhu. "Detecting Small Objects in Thermal Images Using Single-Shot Detector". *Automatic Control and Computer Sciences* Aut. 55, 202–211 (2021).

8. Jin-Jian Xu†, **Hao Zhang**†, Chao-Sheng Tang, Yaowen Yang, Lin Li, Dian-Long Wang, Bo Liu, Bin Shi. "Soil Desiccation Crack Recognition: New Paradigm and Field Application". *Journal of Geophysical Research: Machine Learning and Computation*, accpeted, doi: 10.1029/2024JH000347. (Co-first author)

9. Jin-Jian Xu, **Hao Zhang**, Chao-Sheng Tang, Qing Cheng, Bo Liu, Bin Shi, "Automatic Soil Desiccation Crack Recognition Using Deep Learning", *Géotechnique* 2022 72:4, 337-349. **Highly Cited Paper & 75th Géotechnique Anniversary Early Career Award (insightful paper on Artificial Intelligence and Statistics in geotechnics published in the decade 2013-2023)**

10. Jin-Jian Xu, **Hao Zhang**, Chao-Sheng Tang, Qing Cheng, Ben-gang Tian, Bo Liu, and Bin Shi. "Automatic Soil Crack Recognition Under Uneven Illumination Condition with The Application of Artificial Intelligence", *Engineering Geology*, 2021. https://doi.org/10.1016/j.enggeo.2021.106495.

11. Lu Yuan, **Hao Zhang**, Ming Xu, Fuhui Zhou, and Qihui Wu. "A Multi-Scale CNN Framework for Wireless Technique Classification in Beyond 5G Communications", *IEEE Internet of Things Journal*, vol. 9, no. 12, pp. 10366-10367, 15 June15, 2022, doi: 10.1109/JIOT.2021.3132652.

12. Rui Ding, **Hao Zhang**, Fuhui Zhou, Qihui Wu, and Zhu Han. "Data-and-Knowledge Dual-Driven Automatic Modulation Recognition for Wireless Communication Networks", *IEEE ICC 2022– IEEE International Conference on Communications*, 2022, pp. 1962-1967, doi: 10.1109/ICC45855.2022.9838977.

13. Qingcai Wang, **Hao Zhang**, Xianggong Hong, and Qinqin Zhou. "Small Object Detection Based on Modified FSSD and Model Compression". *2021 IEEE 6th International Conference on Signal and Image Processing (ICSIP)*, 2021, pp. 88-92, doi: 10.1109/ICSIP52628.2021.9688896.

14. Qinqin Zhou, **Hao Zhang**, and Suya Wang. "Artificial Intelligence, Big Data, and Blockchain in Food Safety, *International Journal of Food Engineering*, vol. 18, no. 1, 2022, pp. 1-14.

15. Linsheng Hu, Yihao Li, **Hao Zhang**, Lu Yuan, Fuhui Zhou, and Qihui Wu, "Robust semantic communications driven by knowledge graph", *The 9th International Conference on Internet of Things: Systems, Management and Security (IOTSMS 2022)*, 2022, pp. 1-5, doi: 10.1109/IOTSMS58070.2022.10061867.

16. Ming Xu, Yuhang Wu, **Hao Zhang**, Lu Yuan, Yiyao Wan, Fuhui Zhou, and Qqihui Wu, "GAN-enabled robust backdoor attack for UAV recognition", *2022 International Conference on Communication, Image and Signal Processing (CCISP 2022)*, 2022, pp. 474-478, doi: 10.1109/CCISP55629.2022.9974216.

17. Ruitao Wang, **Hao Zhang**, Ming Xu, Fuhui Zhou, Qihui Wu. "A Novel Lightweight Automatic Modulation Classification Scheme Based on Inverted Residuals", *2023 International Conference on Ubiquitous Communication (Ucom)*, Xi'an, China, 2023, pp. 259-263.

18. Dongjun Han, **Hao Zhang**, Shujie Wang, Wei Chai, Haonan Zhou, Fuhui Zhou. "Small Objects Recognition by Exploiting an Improved YOLOv5 Algorithm on the UAV Platform", *2023 International Conference on Ubiquitous Communication (Ucom)*, Xi'an, China, 2023, pp. 193-198.

19. Jin-Jian Xu, Chao-Sheng Tang, Yaowen Yang, Lin Li, **Hao Zhang**, Qing Cheng, Xi-Ying Zhang, Bo Liu, and Bin Shi. "Breathing Phenomenon of Soil Desiccation Cracking: Insights From Novel Geophysical Observations". *Journal of Geophysical Research: Earth Surface* 129 (2024): e2023JF007318.

Preprints

1. **Hao Zhang**, Jin-Jian Xu, Hong-Wei Cui, Lin Li, Yaowen Yang, Chao-Sheng Tang, and Niklas Boers. "When Geoscience Meets Foundation Models: Towards General Geoscience Artificial Intelligence System", *IEEE Geoscience and Remote Sensing Magazine* (minor revision)

2. **Hao Zhang**, Fuhui Zhou, Hongyang Du, Qihui Wu, and Chau Yuen. "Revolution of Wireless Signal Recognition for 6G: Recent Advances, Challenges and Future Directions", *IEEE Communications Surveys & Tutorials* (under review)

3. **Hao Zhang**, Fuhui Zhou, Qihui Wu, and Chau Yuen. "Spectrum Cognition: Semantic Situation for Next-Generation Spectrum Management", *IEEE Wireless Communications* (under review)

4. **Hao Zhang**, Fuhui Zhou, Wei Wang, Qihui Wu, and Chau Yuen. "A Federated Learning-based Lightweight Network with Zero Trust for UAV Authentication", *IEEE Transactions on Information Forensics and Security* (under review)

5. **Hao Zhang**, Fuhui Zhou, Qihui Wu, and Chau Yuen. "Distributed Multi-Task Learning for Joint Wireless Signal Enhancement and Recognition", *IEEE Journal on Selected Topics in Signal Processing* (under review)

6. **Hao Zhang**, Fuhui Zhou, Qihui Wu, and Chau Yuen. "FSOS-AMC: Few-Shot Open-Set Learning for Automatic Modulation Classification Over Multipath Fading Channels", *IEEE Internet of Things Journal* (under review)

7. Jin-Jian Xu†, **Hao Zhang**†, Chao-Sheng Tang, Mohamed Ramy El-Maarry, Yao-Wen Yang, Lin Li, Bin Shi. "Drying Induces Mars Intermediate-Sized Cracks: New Evidence and Insight from Geometrical Quantification". (under review) (Co-first author)

8. Jin-Jian Xu†, **Hao Zhang**†, Chaosheng Tang, Lin Li, Dazhan Zhang, Dianlong Wang, and Bin Shi. "XGeoS-AI: An Interpretable Learning Framework for Deciphering Geoscience Image Segmentation". (under review) (Co-first author)

9. Qihui Wu, Shijin Zhao, Fuhui Zhou, **Hao Zhang**, Yang Huang, Kai-Kuang Ma. Cognitive Escape Reinforcement Learning for Complex Decision Making. *Science China: Information Science*, https://doi.org/10.21203/rs.3.rs-2661516/v1 (under review)

Patents

1. **Hao Zhang**, Fuhui Zhou, Jiaxin Ding, Liang Chang, Shengmei Luo, Zhihong Lu, and Qihui Wu. "Semi-supervised intelligent and accurate identification method for few sample wireless signals", applying for Chinese Invention Patent

2. Fuhui Zhou, Rui Ding, Ming Xu, **Hao Zhang**, Lu Yuan, Qihui Wu and Chao Dong. A data-knowledge dual-driven modulation intelligent identification method. Chinese Invention Patent (Authorize: CN 114157539 B)

3. Fuhui Zhou, Rui Ding, Ming Xu, **Hao Zhang**, Lu Yuan, Qihui Wu and Chao Dong. INTELLIGENT DATA AND KNOWLEDGE-DRIVEN METHOD FOR MODULATION RECOGNITION. U.S. Patent (Application: 17/901,86)

Projects

Few Sample Modulation Identification under High Dynamic Environment

Nanjing, China

PI *2023.06-2024.06*

- **Postgraduate Research and Practice Innovation Program of Jiangsu Province (Grant No. KYCX23_0380)**. The goal of this project is the identification of wireless signal under high dynamic environment.

Research on Comprehensive Mechanical Performance of Coral Concrete Foundation Island and Reef Wind Turbines Based on Interpretable Deep Learning

Nanjing, China

Co-PI *2023.05-2024.06*

- **Interdisciplinary Innovation Fund for Doctoral Students of Nanjing University of Aeronautics and Astronautics (Grant No. KXKCXJJ202302)**. The goal of this project is to investigate the interpretable deep learning models.

Nonconvex Optimization Theory of Multi-domain Resources in Wireless Networks

Nanjing, China

Main participants *2023.01-2025.12*

- **National Outstanding Youth Science Fund**. The goal of this project is to apply machine learning to multi-domain resource optimization, and realize multi-domain resource intelligent management and control.

Deep spectrum cognition in multi-system complex dynamic environment

Nanjing, China

Main participants *2021.01-2023.12*

- **National Key Research and Development Project**. The goal of this project is to apply deep learning for wireless signal recognition ans spectrum sensing.

Honors & Awards

2023.11	**75th Géotechnique Anniversary Early Career Award**, Institute of Civil Engineers (ICE)	*London*
2023.07	**Chinese Government Scholarship**, Chinese Scholarship Council (CSC)	*Nanjing*
2022.05	**28/year**, Graduate Top-notch Innovative Talents Training Program “Yinhang Program”	*Nanjing*
2020.06	**4%**, Outstanding Graduates of Nanchang University	*Nanchang*
2020.06	**1st Prize**, Graduate Scholarship of Nanchang University	*Nanchang*
2019.05	**1st Prize**, Graduate Scholarship of Nanchang University	*Nanchang*
2018.05	**2nd Prize**, Graduate Scholarship of Nanchang University	*Nanchang*
2017.07	**3rd Prize**, 12th Graduate Electronics Design Contest (Huazhong Zone)	*Changsha*
2017.05	**1st Prize**, Scholarship of Nanchang University	*Nanchang*
2016.11	**1st Prize**, Scholarship of Nanchang University	*Nanchang*
2015.11	**Speical Grade**, Scholarship of Nanchang University	*Nanchang*
2014.11	**1st Prize**, Scholarship of Nanchang University	*Nanchang*
2014.05	**Excellent League Member**, Excellent Students of Nanchang University	*Nanchang*
2014.04	**2nd Prize**, Scholarship of Nanchang University	*Nanchang*