Hao Zhang

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Dr. Hao Zhang is currently an Assistant Researcher/Postdoctoral Fellow at the College of Artificial Intelligence, Nanjing University of Aeronautics and Astronautics (NUAA). He was awarded the **Excellent Doctoral Dissertation Award of China Electronics Education Society (CESE)** in 2025, and was selected as a member of NUAA's Top-notch Postgraduate Innovative Talents Training "Yinhang Project". He obtained the Ph.D. degree in Information and Communication Engineering at NUAA in June 2025.

His research interests include **foundation models, signal classification/processing, and wireless networks**. He has published over 30 papers in IEEE top journals and conferences such as IEEE COMST, IEEE JSAC, IEEE TIFS, IEEE TCOM, and IEEE TCCN (Citations: **800+**, H-index: **17**.), including 2 **ESI highly cited paper**, and one **cover story**.

Education & Work Experience

now 2025.06.23	College of Artificial Intelligence, **Nanjing University of Aeronautics and Astronautics** Assistant Researcher/Postdoctoral Fellow in Computer Science
2025.06.20 2021.04	College of Electronic & Information Engineering, **Nanjing University of Aeronautics and Astronautics** Ph.D. (Supervisor: Prof. Fuhui Zhou) (2020.07–2021.03 served as research assistant) in Information and Communication Engineering
2024.12 2024.01	School of Electrical & Electronic Engineering, **Nanyang Technological University** Visiting Ph.D. Student (Supervisor: Prof. Chau Yuen, IEEE Fellow) in Information and Communication Engineering
2020.06.24 2017.09	School of Information Engineering, **Nanchang University** Master of Engineering in Electrical and Communication Engineering
2017.06.22 2013.09	School of Information Engineering, **Nanchang University** Bachelor's Degree in Internet of Things Engineering

Publications

Journal Articles

[1] **H. Zhang**, F. Zhou, H. Du, Q. Wu, and C. Yuen, "Revolution of wireless signal recognition for 6G: Recent advances, challenges and future directions," *IEEE Communications Surveys & Tutorials*, vol. 28, pp. 3521–3563, 2026, **ESI Highly Cited Paper**. DOI: 10.1109/COMST.2025.3569427.

[2] **H. Zhang**, F. Zhou, Q. Wu, and C. Yuen, "Distributed multi-task learning for joint wireless signal enhancement and recognition," *IEEE Transactions on Cognitive Communications and Networking*, vol. 12, pp. 1554–1568, 2026. DOI: 10.1109/TCCN.2025.3612750.

[3] **H. Zhang**, J.-J. Xu, H.-W. Cui, L. Li, Y. Yang, C.-S. Tang, and N. Boers, "When geoscience meets foundation models: Towards general geoscience artificial intelligence system," *IEEE Geoscience and Remote Sensing Magazine*, vol. 13, no. 4, pp. 79–118, 2025. DOI: 10.1109/MGRS.2024.3496478.

[4] **H. Zhang**, F. Zhou, W. Wang, Q. Wu, and C. Yuen, "A federated learning-based lightweight network with zero trust for UAV authentication," *IEEE Transactions on Information Forensics and Security*, vol. 20, pp. 7424–7437, 2025. DOI: 10.1109/TIFS.2025.3587624.

[5] **H. Zhang**, F. Zhou, Q. Wu, and C. Yuen, "FSOS-AMC: Few-shot open-set learning for automatic modulation classification over multipath fading channels," *IEEE Internet of Things Journal*, vol. 12, no. 12, pp. 18 718–18 731, 2025. DOI: 10.1109/JIOT.2025.3557973.

[6] **H. Zhang**, F. Zhou, Q. Wu, and C. Yuen, "Spectrum cognition: Semantic situation for next-generation spectrum management," *IEEE Network*, 2025. DOI: 10.1109/MNET.2025.3604901.

[7] **H. Zhang**, F. Zhou, Q. Wu, and N. 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, 2024. DOI: 10.1109/TCOMM.2024.3385921.

[8] **H. Zhang**, F. Zhou, Q. Wu, W. Wu, and R. Q. 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, 2022. DOI: 10.1109/TCCN.2021.3091730.

[9] **H. Zhang**, X. Hong, and L. Zhu, "Detecting small objects in thermal images using single-shot detector," *Automatic Control and Computer Sciences*, vol. 55, no. 2, pp. 202–211, 2021. DOI: 10.3103/S0146411621020097.

[10] **H. Zhang**, L. Yuan, G. Wu, F. Zhou, and Q. Wu, "Efficient automatic modulation classification using involution based residual networks," *IEEE Wireless Communications Letters*, vol. 10, no. 11, pp. 2417–2420, 2021. DOI: 10.1109/LWC.2021.3102069.

[11] **H. Zhang**, and X. Hong, "Recent progresses on object detection: A brief review," *Multimedia Tools and Applications*, vol. 78, pp. 27 809–27 847, 2019, **CCF-C**. DOI: 10.1007/s11042-019-07898-2.

[12] J.-J. Xu, **H. Zhang**, C.-S. Tang, Y. Yang, M. R. El-Maarry, L. Li, and B. Shi, "Drying induces mars intermediate-sized cracks: New evidence and insight from geometrical quantification," *Icarus*, p. 117 026, 2026, ***Cover Story**, Co-first author*. DOI: 10.1016/j.icarus.2026.117026.

[13] J.-J. Xu, **H. Zhang**, C.-S. Tang, L. Li, and B. Shi, "XGeoS-AI: An interpretable learning framework for deciphering geoscience image segmentation," *Environmental Earth Sciences*, vol. 84, no. 3, p. 97, 2025. DOI: 10.1007/s12665-025-12095-6.

[14] J.-J. Xu, **H. Zhang**, C.-S. Tang, Y. Yang, L. Li, D.-L. Wang, B. Liu, and B. Shi, "Soil desiccation crack recognition: New paradigm and field application," *Journal of Geophysical Research: Machine Learning and Computation*, vol. 1, no. 3, e2024JH000347, 2024, *Co-first author*. DOI: 10.1029/2024JH000347.

[15] J.-J. Xu, **H. Zhang**, C.-S. Tang, Q. Cheng, B. Liu, and B. Shi, "Automatic soil desiccation crack recognition using deep learning," *Géotechnique*, vol. 72, no. 4, pp. 337–349, 2022, **ESI Highly Cited Paper** & 75th Géotechnique Anniversary Early Career Award. DOI: 10.1680/jgeot.20.P.091.

[16] J.-J. Xu, **H. Zhang**, C.-S. Tang, Q. Cheng, B.-g. Tian, B. Liu, and B. Shi, "Automatic soil crack recognition under uneven illumination condition with the application of artificial intelligence," *Engineering Geology*, vol. 296, p. 106 495, 2022. DOI: 10.1016/j.enggeo.2021.106495.

[17] L. Yuan, **H. Zhang**, M. Xu, F. Zhou, and Q. Wu, "A multi-scale CNN framework for wireless technique classification in beyond 5G communications," *IEEE Internet of Things Journal*, vol. 9, no. 12, pp. 10 366–10 367, 2022. DOI: 10.1109/JIOT.2021.3132652.

[18] Q. Zhou, **H. Zhang**, and S. Wang, "Artificial intelligence, big data, and blockchain in food safety," *International Journal of Food Engineering*, vol. 18, no. 1, pp. 1–14, 2022. DOI: 10.1515/ijfe-2021-0299.

[19] S. Zhao, Q. Wu, F. Zhou, **H. Zhang**, Y. Huang, and K.-K. Ma, "Cognitive escape reinforcement learning for complex decision making," *IEEE Transactions on Vehicular Technology*, pp. 1–13, 2025. DOI: 10.1109/TVT.2025.3597537.

[20] F. Zhou, C. Liu, **H. Zhang**, W. Wu, Q. Wu, T. Q. S. Quek, and C.-B. Chae, "SpectrumFM: A foundation model for intelligent spectrum management," *IEEE Journal on Selected Areas in Communications*, 2025. DOI: 10.1109/JSAC.2025.3644783.

[21] J.-J. Xu, C.-S. Tang, Y. Yang, L. Li, **H. Zhang**, Q. Cheng, X.-Y. Zhang, B. Liu, and B. Shi, "Breathing phenomenon of soil desiccation cracking: Insights from novel geophysical observations," *Journal of Geophysical Research: Earth Surface*, vol. 129, no. 1, e2023JF007318, 2024. DOI: 10.1029/2023JF007318.

Conference Papers

[22] **H. Zhang**, F. Zhou, Q. Wu, and C. Yuen, "FSOS-AMC: Few-shot open-set learning for automatic modulation classification," *Proc. 16th Int. Conf. Wireless Communications and Signal Processing (WCSP)*, 2024, pp. 746–751. DOI: 10.1109/WCSP62071.2024.10826902.

[23] **H. Zhang**, X. Hong, S. Zhou, and Q. Wang, "Infrared image segmentation for photovoltaic panels based on Res-UNet," *Proc. Chinese Conf. Pattern Recognition and Computer Vision (PRCV). LNCS, vol. 11857*, **CCF-C**, 2019, pp. 611–622. DOI: 10.1007/978-3-030-31654-9_52.

[24] C. Liu, **H. Zhang**, F. Zhou, W. Wu, Q. Wu, D. W. K. Ng, T. Q. S. Quek, and C.-B. Chae, "SpectrumFM: Redefining spectrum cognition via foundation modeling," *Proc. IEEE Global Communications Conference (GLOBECOM)*, 2025, pp. 3861–3866. DOI: 10.1109/GLOBECOM59602.2025.11432674.

[25] Z. Tong, **H. Zhang**, M. Xu, and F. Zhou, "An accurate few-shot spectrum anomaly detection method using the contrastive language-image pre-training model," *Proc. 3rd Int. Conf. Ubiquitous Communication (Ucom)*, 2025, pp. 220–224. DOI: 10.1109/Ucom67224.2025.11336960.

[26] D. Han, **H. Zhang**, S. Wang, W. Chai, H. Zhou, and F. Zhou, "Small objects recognition by exploiting an improved YOLOv5 algorithm on the UAV platform," *Proc. Int. Conf. Ubiquitous Communication (Ucom)*, 2023, pp. 193–198. DOI: 10.1109/Ucom59132.2023.10257606.

[27] R. Wang, **H. Zhang**, M. Xu, F. Zhou, and Q. Wu, "A novel lightweight automatic modulation classification scheme based on inverted residuals," *Proc. Int. Conf. Ubiquitous Communication (Ucom)*, 2023, pp. 259–263. DOI: 10.1109/Ucom59132.2023.10257638.

[28] R. Ding, **H. Zhang**, F. Zhou, Q. Wu, and Z. Han, "Data-and-knowledge dual-driven automatic modulation recognition for wireless communication networks," *Proc. IEEE International Conference on Communications (ICC)*, 2022, pp. 1962–1967. DOI: 10.1109/ICC45855.2022.9838977.

[29] Q. Wang, **H. Zhang**, X. Hong, and Q. Zhou, "Small object detection based on modified FSSD and model compression," *Proc. 6th IEEE Int. Conf. Signal and Image Processing (ICSIP)*, 2021, pp. 88–92. DOI: 10.1109/ICSIP52628.2021.9688896.

[30] X. Huang, X. Huang, C. Liu, **H. Zhang**, F. Zhou, and Q. Wu, "From survey to design: Knowledge-enhanced multimodal spectrum foundation model for intelligent spectrum management," *Proc. 3rd Int. Conf. Ubiquitous Communication (Ucom)*, 2025, pp. 231–236. DOI: 10.1109/Ucom67224.2025.11336912.

[31] Y. Wei, X. Liu, **H. Zhang**, F. Zhou, and Q. Wu, "GenSpectraLM: Large model-driven spectrum map construction with electromagnetic propagation," *Proc. IEEE Global Communications Conference (GLOBECOM)*, 2025, pp. 393–398. DOI: 10.1109/GLOBECOM59602.2025.11431695.

[32] M. Xu, H. Ma, **H. Zhang**, F. Zhou, and Q. Wu, "PLMSNet: A pseudo labeling multi-scale network for semi-supervised spectrum sensing," *Proc. IEEE Global Communications Conference (GLOBECOM)*, 2025, pp. 3915–3920. DOI: 10.1109/GLOBECOM59602.2025.11432737.

[33] D. Zhang, X. Yan, H. Ma, M. Xu, **H. Zhang**, and F. Zhou, "YOLOv10-P2: A robust detection scheme for UAV signals in RF spectrograms," *Proc. 3rd Int. Conf. Ubiquitous Communication (Ucom)*, 2025, pp. 249–253. DOI: 10.1109/Ucom67224.2025.11336824.

[34] L. Hu, Y. Li, **H. Zhang**, L. Yuan, F. Zhou, and Q. Wu, "Robust semantic communication driven by knowledge graph," *Proc. 9th Int. Conf. Internet of Things: Systems, Management and Security (IOTSMS)*, 2022, pp. 1–5. DOI: 10.1109/IOTSMS58070.2022.10061867.

[35] M. Xu, Y. Wu, **H. Zhang**, L. Yuan, Y. Wan, F. Zhou, and Q. Wu, "GAN-enabled robust backdoor attack for UAV recognition," *Proc. 7th Int. Conf. Communication, Image and Signal Processing (CCISP)*, 2022, pp. 474–478. DOI: 10.1109/CCISP55629.2022.9974216.

Conference Papers

[36] **H. Zhang**, C. Liu, F. Zhou, and Q. Wu, "Spectrum foundation model: A new paradigm towards general spectrum cognition and decision," *IEEE Wireless Communications*, Under Review, 2026.

[37] Y. Wei, X. Liu, **H. Zhang**, Y. Diao, H. Wu, L. Cao, F. Zhou, and Q. Wu, "Genspectralm-3d: A physics-informed foundation model for 3d electromagnetic spectrum map construction," *IEEE Transactions on Cognitive Communications and Networking*, Under Review, 2026.

[38] M. Xu, X. Yan, **H. Zhang**, F. Zhou, and Q. Wu, "Knowledge enhanced intelligent wireless signal detection and classification for coexisting and overlapping signals," *IEEE Transactions on Mobile Computing*, Under Review, 2026.

Patents & Standards

1. **Hao Zhang**, Fuhui Zhou, Jiaxin Ding, Liang Chang, Shengmei Luo, Zhihong Lu, and Qihui Wu, "A semi-supervised intelligent and accurate recognition method for small sample wireless signals," C.N. Patent (CN 119128666A)

2. Yifan Wei, Xiaodong Liu, **Hao Zhang**, Fuhui Zhou, Qihui Wu, Anping Li, and Liang Chang, "A method for constructing spectral situation based on a large electromagnetic model," C.N. Patent (CN 121547133A)
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)
4. Fuhui Zhou, Dongming Li, Junchang Chen, **Hao Zhang**, and Wei Wu, "Proposed Revision of the Handbook on Spectrum Monitoring (PROPOSED REVISIONS TO SECTION 4.10 OF THE ITU SPECTRUM MONITORING HANDBOOK)," ITU-R R23-WP1C, 1C-RG-SMH/35-E, Oct. 2024.

Projects

2024.12 – 2023.06 | Few-Shot Modulation Identification under High Dynamic Environment
- Postgraduate Research & Practice Innovation Program of Jiangsu Province (Grant KYCX23_0380), **Project Leader**

2024.06 – 2023.06 | Mechanical Performance of Coral Concrete Wind Turbines Based on Interpretable Deep Learning
- Interdisciplinary Innovation Fund for Doctoral Students of NUAA (No. KXKCXJJ202302), **Project Co-Leader**

2020.06 – 2018.06 | Research on Lightweight Convolutional Neural Networks
- Innovation Fund for Graduate Students, Nanchang University (No. CX2018145), **Project Leader**

Honors

- **Excellent Doctoral Dissertation Award, China Electronics Education Society (CESE)**, Dec. 2025
- Excellent Graduates, Nanjing University of Aeronautics and Astronautics, Dec. 2024
- Chinese Government Scholarship, China Scholarship Council (CSC), Jul. 2023
- Top-notch Postgraduate Innovative Talents Training "Yinhang Project" of NUAA, May 2022
- Outstanding Graduates of Nanchang University (4%), Jun. 2020
- The First Prize Graduate Scholarship of Nanchang University, May 2020
- The First Prize Graduate Scholarship of Nanchang University, May 2019
- The Second Prize Graduate Scholarship of Nanchang University, May 2018
- The Third Prize of 12th Graduate Electronics Design Contest (Huazhong), Jul. 2017
- The First Prize Scholarship of Nanchang University, May 2017
- The First Prize Scholarship of Nanchang University, Nov. 2016
- The Special Grade Scholarship of Nanchang University, Nov. 2015
- The First Prize Scholarship of Nanchang University, Nov. 2014
- The Second Prize Scholarship of Nanchang University, Apr. 2014

Other

- **Academic Services:** IEEE Member, CCF, IEEE ComSoc, IEEE GRSS, CAAI; IEEE ICC25-SAC TPC Member; IEEE VTC-Spring 2024 Session Chair and Volunteer
- **Journal Reviewer:** IEEE JSAC, IEEE TNNLS, IEEE GRSM, IEEE CIM, IEEE TIFS, IEEE WCM, IEEE CM, IEEE TWC, IEEE TCOM, IEEE TCCN, IEEE TVT, IEEE IOTJ, IEEE WCL, IEEE CL, IEEE Network, IEEE Systems Journal, China Communications, Scientific Reports
- **Conference Reviewer:** ACM MM 2025, IEEE WCSP 2020, IEEE GLOBECOM 2021/2022/2024, IEEE ICCC 2022, IEEE VTC2022-Fall