Heqin Zhu

Ph.D. candidate ◇ University of Science and Technology of China ◇ Latest CV

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Core Research: AI for Science

- **Computational Biology**: Structure-guided RNA foundation model: structRFM [I8](Nature, Under Revision); IRES identification [I7](Under Revision); RNA secondary structure prediction: BPfold [I6] (Nature Communications), NCfold [I9] (Under Review).
- **Medical Image Computing**: Domain adaptation: GU2Net [I1, I2] (MICCAI 2021, BMEF), DATR [I4]; Few-shot learning: UOD [I5] (MICCAI 2023), SCP [J3] (MIA); Contrastive learning: IGU-Aug [J4] (TMI).

Education

- **University of Science and Technology of China (USTC)** — *Sept. 2023 - Jun. 2026 (expected)*
  Ph.D. Candidate in Biomedical Engineering — Suzhou, China
  ◦ Advisor: Prof. S. Kevin Zhou (Fellow of AIMBE, IAMBE, IEEE, MICCAI, and NAI)
- **Institute of Computing Technology (ICT), Chinese Academy of Sciences (CAS) & University of Chinese Academy of Sciences (UCAS)** — *Sept. 2020 - Jun. 2023*
  Master in Computer Applications — Beijing, China
  ◦ Advisor: Same as above
- **University of Science and Technology of China (USTC)** — *Sept. 2016 - Jun. 2020*
  Bachelor in Computer Science and Technology — Hefei, China
  ◦ Hua Xia Talent Program in Computer Science and Technology

Awards and Honors

- National Scholarship (Top 1%), Chinese Ministry of Education — *2025*
- Suzhou Industrial Park Scholarship, USTC — *2025*
- First Class Scholarship, UCAS & ICT, USTC — *2020-2025*
- Outstanding Student Award, USTC — *2018-2019*
- **Institute of Chemistry Excellence Scholarship**, USTC — *2017*

Project and Internship

- **Structure-guided RNA Foundation Model - structRFM [Paper; Code] 28 stars** — *Aug. 2025*
  First author — Nature, Under Revision
  ◦ Designed a structure-guided masked language modeling pre-training strategy (SgMLM). It selectively masks input tokens corresponding to canonical base pairs within local structural contexts, encouraging the model to recover base-pair interactions based on neighboring loop regions.
  ◦ Carried out comprehensive experiments. Zero-shot homology classification: top of 15. Secondary structure prediction: state-of-the-art. Tertiary structure prediction: 19% improvement VS AlphaFold3 on the RNA Puzzles dataset under RMSD. Functional prediction tasks: F1-score improved by 49% in IRES identification tasks.
- **RNA Secondary Structure Prediction Model - BPfold [Paper; Code] 22 stars** — *Jul. 2025*
  First author — Nature Communications
  ◦ Introduced base pair motif energy at the base pair level to improve data coverage and quality, thereby overcoming the challenge of insufficient experimentally resolved structure data for RNA structure prediction. Designed a multi-modal fusion network BPfold (integrating sequence and energy matrix) to enhance the accuracy and generalization of secondary structure prediction.
- **Tencent, JARVIS Lab** — *Jul. 2021 - Nov. 2021*
  Research Intern — Shenzhen, China
  ◦ Depth-supervised feature fusion transformer for salient object detection. [I3]
  ◦ Open-source project CS learning resources[link] 15k stars: Lead and maintain the project for curating resources for learning computer s icence.

Academic Activities

- Academic Reviewer: MICCAI (medical image analysis), TCSVT (IF=11.1)
- Volunteer Activities: Medical Augmented Reality Summer School (Suzhou, 2024), Dushu Lake Forum Dushu Lake Symposium on Medical Image Computing, (Suzhou, 2023).
- Teaching assistant: "Open Practice in Electronic Information", (USTC, 2023).

Technical Skills

- **Deep learning:** Pytorch, LLM, Diffusion Model, Multi-modality Fusion, C++, Git, VIM

PUBLICATIONS

I=REPRESENTATIVE, J=JOURNAL, C=CONFERENCE

Selected publications, # denotes co-first author and * denotes co-corresponding author. For full list, please refer to Google Scholar.

Representative Papers

[I9] **Heqin Zhu#**, Ruifeng Li#, Ao Chang, Mingqian Li, Hongyang Chen*, Peng Xiong*, and S. Kevin Zhou*. "RNA non-canonical base pair prediction." (Under Review).

[I8] **Heqin Zhu**, Ruifeng Li, Feng Zhang, Fenghe Tang, Tong Ye, Xin Li, Yunjie Gu, Peng Xiong*, and S. Kevin Zhou*. "A fully open structure-guided RNA foundation model for robust structural and functional inference." (Nature, Under Revision). [bioRxiv; Code]

[I7] Feng Zhang#, **Heqin Zhu#**, Jie Hu, Jiayin Gao, Ke Chen, S. Kevin Zhou*, and Peng Xiong*. "IRESeek: Structure-informed deep learning method for accurate identification of internal ribosome entry sites in circular RNAs." (Under Revision).

[I6] **Heqin Zhu**, Fenghe Tang, Quan Quan, Ke Chen, Peng Xiong*, and S. Kevin Zhou*. "Deep generalizable prediction of RNA secondary structure via base pair motif energy." Nature Communications 16, (2025): 5856. (Nat. Commun., 2025). [Paper; Code]

[I5] **Heqin Zhu**, Quan Quan, Qingsong Yao, Zaiyi Liu, and S. Kevin Zhou. "Uod: Universal one-shot detection of anatomical landmarks." In International Conference on Medical Image Computing and Computer-Assisted Intervention, pp. 24-34. Cham: Springer Nature Switzerland, 2023. (MICCAI 2023). [Paper; Code]

[I4] **Heqin Zhu**, Qingsong Yao, and S. Kevin Zhou. "Datr: Domain-adaptive transformer for multi-domain landmark detection." arxiv preprint arxiv:2203.06433 (2022). [Paper; Code]

[I3] **Heqin Zhu**, Xu Sun, Yuexiang Li, Kai Ma, S. Kevin Zhou*, and Yefeng Zheng*. "DFTR: Depth-supervised fusion transformer for salient object detection." arxiv preprint arxiv:2203.06429 (2022). [Paper; Code]

[I2] **Heqin Zhu**, Qingsong Yao, Li Xiao, and S. Kevin Zhou. "Learning to Localize Cross-Anatomy Landmarks in X-Ray Images with a Universal Model." BME Frontiers 2022 (2022): 9765095. (BMEF 2022). [Paper; Code]

[I1] **Heqin Zhu**, Qingsong Yao, Li xiao, and S. Kevin Zhou. "You only learn once: Universal anatomical landmark detection." In Medical Image Computing and Computer Assisted Intervention, pp. 85-95. Springer International Publishing, 2021. (MICCAI 2021). [Paper; Code]

Journal Papers

[J4] Quan Quan#, Qingsong Yao#, **Heqin Zhu**, and S. Kevin Zhou. "IGU-Aug: Information-guided unsupervised augmentation and pixel-wise contrastive learning for medical image analysis." IEEE Transactions on Medical Imaging (2024). (TMI 2024).

[J3] Quan Quan#, Qingsong Yao#, **Heqin Zhu**, Qiyuan Wang, and S. Kevin Zhou. "Which images to label for few-shot medical image analysis?." Medical Image Analysis 96 (2024): 103200. (MIA 2024).

[J2] Huang Zhen#, Han Li#, Shitong Shao, **Heqin Zhu**, Huijie Hu, Zhiwei Cheng, Jianji Wang, and S. Kevin Zhou. "PELE scores: pelvic X-ray landmark detection with pelvis extraction and enhancement." International Journal of Computer Assisted Radiology and Surgery 19, no. 5 (2024): 939-950. (IJCARS 2024).

[J1] Pengbo Liu, Hu Han, Yuanqi Du, **Heqin Zhu**, Yinhao Li, Feng Gu et al. "Deep learning to segment pelvic bones: large-scale CT datasets and baseline models." International Journal of Computer Assisted Radiology and Surgery 16 (2021): 749-756. (IJCARS 2021).

Conference Papers

[C4] Xinyi Wang, Zikang Xu, **Heqin Zhu**, Qingsong Yao, Yiyong Sun, and S. Kevin Zhou. "SIX-Net: Spatial-Context Information miX-up for Electrode Landmark Detection." In International Conference on Medical Image Computing and Computer-Assisted Intervention, pp. 338-348. Cham: Springer Nature Switzerland, 2024. (MICCAI 2024).

[C3] Fenghe Tang, Ronghao Xu, Qingsong Yao, Xueming Fu, Quan Quan, **Heqin Zhu**, Zaiyi Liu, and S. Kevin Zhou. "Hyspark: Hybrid sparse masking for large scale medical image pre-training." In International Conference on Medical Image Computing and Computer-Assisted Intervention, pp. 330-340. Cham: Springer Nature Switzerland, 2024. (MICCAI 2024).

[C2] Quan Quan, Fenghe Tang, Zikang Xu, **Heqin Zhu**, and S. Kevin Zhou. "Slide-SAM: Medical SAM Meets Sliding Window." In Medical Imaging with Deep Learning, pp. 1179-1195. PMLR, 2024. (MIDL 2024).

[C1] Yuanyuan Lyu, Haofu Liao, **Heqin Zhu**, and S. Kevin Zhou. "A 3 DSegNet: anatomy-aware artifact disentanglement and segmentation network for unpaired segmentation, artifact reduction, and modality translation." In International Conference on Information Processing in Medical Imaging, pp. 360-372. Cham: Springer International Publishing, 2021. (IPMI 2021).