

朱河勤

中国科学技术大学

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核心研究: AI FOR SCIENCE

- 计算生物学: 基于大模型的 RNA 结构与功能预测。主导开发结构引导的 RNA 基础语言模型 structRFM [I8]; 提出碱基对基序能量, 并设计 RNA 二级结构预测模型 BPfold, 发表于 *Nature Communications* (IF=15.7) [I6]。
- 医学影像计算: 跨域通用型解剖关键点检测。研发 GU2Net [I1, I2], DATR [I4], UOD [I5], 等模型, 发表两篇 MICCAI (CCF B, 2021, 2023), 一篇 *BME Frontiers* (JCR Q1, IF=7.7)。

教育经历

- 中国科学技术大学 2023.09 - 2026 (预计)
博士研究生, 生物医学工程 苏州
。导师: 周少华教授 (Fellow of AIMBE, IAMBE, IEEE, MICCAI, and NAI)
- 中国科学院, 计算技术研究所&中国科学院大学 2020.09 - 2023.06
硕士, 计算机应用技术 北京
。导师: 同上
- 中国科学技术大学 2016.09 - 2020.06
本科, 计算机科学与技术 合肥
。华夏计算机科学与技术英才班

荣誉获奖

- 苏州工业园区奖学金, 中国科学技术大学 2025
- 一等学业奖学金, 中国科学技术大学 2024-2025
- 一等学业奖学金, 计算所&国科大 2020-2023
- 三好学生, 计算所&国科大 2023
- 优秀学生奖, 中国科学技术大学 2018-2019
- 化研所英才奖, 中国科学技术大学 2017

项目实习

- 结构引导的 RNA 基础模型 structRFM [Paper; Code] 20 stars 2025.08
独立一作 Submitted
。融合序列与结构信息的大规模 RNA 基础模型。通过创新的配对匹配掩码机制, 它将碱基配对信息直接融入语言建模, 并动态平衡碱基级与结构级的掩码比例。
。在零样本同源分类任务上, 15个生物语言模型中排名领先。
。二级结构预测: 刷新现有方法最佳成绩。
。三级结构预测: 在 RNA Puzzles 数据集上相比 AlphaFold3 提升19%。
。功能预测等任务: IRES 识别任务 F1分数提升49%。
- RNA 二级结构预测 BPfold [Paper; Code] 18 stars 2025.07
独立一作 Nature Communications
。从碱基对层面引入碱基对模体能量来提高数据的覆盖率和质量, 从而克服 RNA 结构预测实验解析结构数据严重不足的难题。设计序列与能量矩阵多模态融合网络 BPfold, 提高了二级结构的预测准确性和模型泛化性。
- 腾讯天衍实验室 2021.07 - 2021.11
研究实习生 深圳
。使用深度图监督学习进行图像显著性检测, 开发了DFTR 多模态融合模型 [I3]
。计算机学习资源整理 GitHub 开源项目 [link] 15.7K stars: 主导整理了计算机相关的学习资源。

学术活动

- 学术审稿: MICCAI (CCF B), TCSVT (IF=11.1): 负责 AI 在医学影像, 生物信息领域的论文评审。
- 志愿活动: 医学影像计算会议 (2023), 增强现实夏季学期 (2024): 协助会议组织论坛, 促进产学研合作。
- 助教: 电子信息开放实践: 中国科学技术大学 2023 年秋季学期。

技术技能

- 大模型与深度学习: PyTorch, 语言模型, 扩散模型, 多模态融合, LoRA
- 科学计算工具: Pandas, Numpy, AlphaFold3, Protenix, PyMol
- 编程语言与工具: Python, C, C++, Git, bash, VIM

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

Representative Papers

- [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." ([Submitted](#)). [[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." ([Submitted](#)).
- [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](#)).