

Muyi Bao

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EDUCATION

Carnegie Mellon University (CMU)

M.S. in Electrical and Computer Engineering (Current)

Pittsburgh, Pennsylvania, United States

June 2027 (Expected)

Xi'an Jiaotong-Liverpool University (XJTLU)

Bachelor of Engineer in Computer Science and Technology

Suzhou, China

Sep 2021—Jun 2025

- **Cumulative GPA:** 3.92 /4.0 (First Class Honors)
- **Honors:** Academic Excellent Awards (Top 5%, 2023-2024, 2024-2025 academic years)

Publications (First Author)

- **Vision Mamba in Remote Sensing: A Comprehensive Survey of Techniques, Applications and Outlook**
M Bao, S Lyu, Z Xu, H Zhou, J Ren, S Xiang, X Li, G Cheng
International Journal of Applied Earth Observation and Geoinformation (Q1, IF: 8.6, under review)
- **FTCFormer: Fuzzy Token Clustering Transformer for Image Classification**
M Bao, C Zeng, Y Wang, Z Yang, Z Wang, G Cheng, J Qi, W Wang
European Conference on Artificial Intelligence (ECAI, CCF-B)
- **ASP-VMUNet: Atrous Shifted Parallel Vision Mamba U-Net for Skin Lesion Segmentation**
M Bao, S Lyu, Z Xu, Q Zhao, C Zeng, W Bai, G Cheng
Engineering Applications of Artificial Intelligence (EAAI, Q1, IF 8.0, under review)
- **Comparative Performance Analysis of Rendering Optimization Methods in Unity Tjanjie Engine, Unity Global and Unreal Engine**
M Bao, Z Tao, X Wang, J Liu, Q Sun
IEEE International Conference on Ubiquitous Intelligence and Computing (UIC, CCF-C)
- **AlexCapsNet: An Integrated Network to Improve Capsule Network with Background Noise**
M Bao, N Jin, M Xu
IEEE Access (Q4, IF: 3.6)

Research Experiences

Vision Mamba in Remote Sensing: A Comprehensive Survey of Techniques, Applications and Outlook

Research Project, Advisor: Dr. Guangliang Cheng, University of Liverpool

Feb. 2025-May. 2025

- Conducted a systematic **review** of **120+** Mamba-based studies in remote sensing, establishing the first taxonomy for micro/macro-advancements, and downstream applications. The survey bridges the gap between State Space Model (SSM) theory and remote sensing practice.
- **Micro-architecture:**
 - SSM Formulations: First comprehensive analysis of SSM advancements, organized into 3 distinct categories.
 - Scan Strategies: Proposed a novel taxonomy classifying 44 scanning methods across 5 components
 - Multimodal Interaction: Provided the first in-depth analysis of techniques for multimodal and bi-temporal feature interaction, identifying 4 methodological categories.
- **Macro-architecture:** Surveyed hybrid CNN/Transformer-Mamba designs, substitutions in frameworks (U-Net, YOLO, Diffusion Models), and frequency-domain operations (FFT, Wavelet).
- **Benchmarking:** Rigorous benchmarking against state-of-the-art methods in multiple application tasks, including object detection, semantic segmentation, change detection, etc.
- **Future Directions:** Identified 7 critical research directions, such as causality mitigation, computational efficiency issue, 3D scan strategies for hyperspectral data, and Mamba-based foundation models, etc.
- The paper was under review by International Journal of Applied Earth Observation and Geoinformation (Q1, IF 8.6).

FTCFormer: Fuzzy Token Clustering Transformer for Image Classification

Research Project, Advisor: Dr. Wei Wang, XJTLU

Jan. 2025-May. 2025

- Proposed **FTCFormer**, a Transformer-based architecture with **clustering-based downsampling layers**, outperforming baseline on 32 datasets. Specifically, achieve average improvement of 1.43% on five fine-grained datasets, 1.09% on six natural datasets, 0.97% on three medical datasets and 0.55% on four remote sensing datasets.
- Designed a clustering-based downsampling layer, **Fuzzy Token Clustering and Merging (FTCM) module**:
 - DPC-FKNN**: Introduced Density Peak Clustering-Fuzzy K-Nearest-Neighbor (DPC-FKNN), which incorporates both KNN set and distance-weighted FKNN set (outside of the KNN set) to determine clustering centers.
 - SCS metric**: Designed a new metric Spatial Connectivity Score (SCS) for token assignment to mitigate the limitations of solely relying on the Euclidean distance.
 - Cmerge**: Proposed Channel Merging (Cmerge) for token merging process, which preserves fine-grained semantic information at channel level instead of token level.
- The paper was accepted by the European Conference on Artificial Intelligence (ECAI, CCF-B)

ASP-VMUNet: Atrous Shifted Parallel Vision Mamba U-Net for Skin Lesion Segmentation

Individual Project, Advisor: Dr. Guangliang Cheng, University of Liverpool

Jun. 2024-Oct. 2024

- Proposed **ASP-VMUNet**, a novel CNN-Mamba-based hybrid U-Net architecture for skin lesion segmentation task, achieving state-of-the-art performance on ISIC16/17/18 and PH2 datasets.
- Designed **Atrous Scan**, a scan sampling strategy for Mamba, which reduces background interference and expands the receptive field, improving MIOU by 0.60%, 0.51%, 0.66% and 0.49% on PH2, ISIC16/17/18, respectively.
- Introduced **Shift Round operation** to enhance feature communication between channel dimension within Mamba layers without additional parameters, increasing MIOU by 0.60%, 0.49% and 0.26% on PH2 and ISIC16/18, respectively.
- Developed a hybrid CNN-Mamba framework with **SK-Net** for dynamic fusion of local and global features, outperforming direct addition methods by 1.01%, 0.65%, 1.40%, 0.39% on PH2 and ISIC16/17/18, respectively.
- The paper was under review by Engineering Applications of Artificial Intelligence (EAAI, Q1, IF 8.0)

Comparative Performance Analysis of Rendering Optimization Methods in Unity Tuanjie Engine, Unity Global and Unreal Engine

Group leader, Advisor: Dr. Qilei Sun, XJTLU

Mar. 2024-Jun. 2024

- Conducted a comparative performance analysis of optimization methods in Unity Tuanjie Engine, Unity Global Engine and Unreal Engine 5 (UE5).
- Constructed a benchmark scene with 10 3D mesh models (each containing 3 million polygons) and evaluated GPU, FPS, CPU, RAM consumption at 100 milliseconds intervals over 4 minutes across five distance levels.
- Concluded that UE5's Nanite system was the best performer. Tuanjie's Virtual Geometry system outperforms Unity Global's LOD system in rendering distant objects, but underperformed when rendering close-up objects.
- The paper was accepted by the IEEE Conference on Ubiquitous Intelligence and Computing (UIC, CCF-C).

AlexCapsNet: An Integrated Network to Improve Capsule Network with Background Noise

Individual Project, Advisor: Dr. Nanlin Jin and Dr. Ming Xu, XJTLU

Sept. 2023 – Dec. 2023

- Propose **AlexCapsNet**, a hybrid architecture combining AlexNet and Capsule Network (CapsNet), achieving superior image classification accuracy over baseline CapsNet variants on MNIST, FMNIST, and CIFAR10.
- Investigated the impact of the Reconstruction Module: revealing its removal enhances model robustness on noisy datasets (Flowers102, Food101, CIFAR) while maintaining competitive accuracy.
- Conducted depth analysis of feature extraction layers: demonstrating that shallow layers improve performance on fine-grained datasets (100+ categories), whereas deeper layers excel on simpler datasets.
- The paper was accepted by IEEE Access (Q4, IF 3.6)

Skills

- Languages: Chinese (Native), English (TOEFL iBT:100/120)
- Technical Skills: Proficient in Python; Familiar in C, C++, Java, MATLAB