Kanglei Zhou

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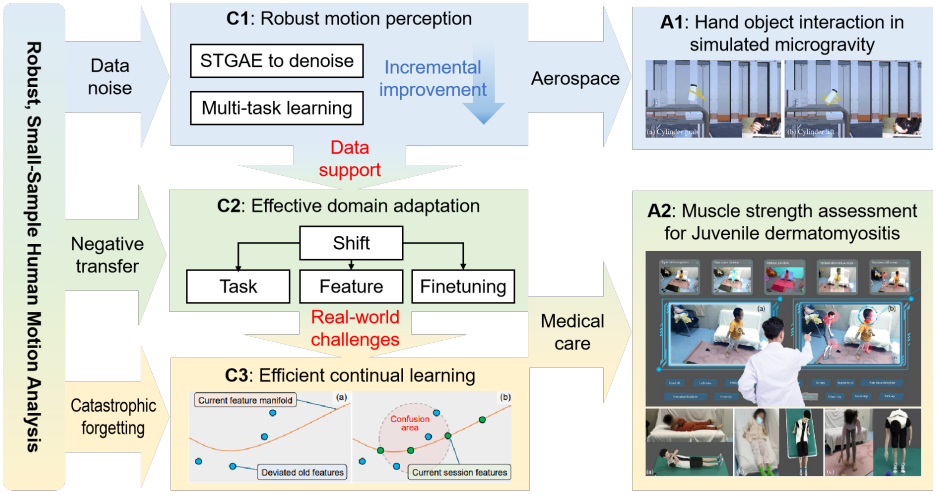
Research Interests

Research on small-sample, fine-grained human motion analysis methods using computer vision and augmented reality techniques, and structured knowledge.



During my PhD, I focused on three key scientific problems that are interrelated and distinct: abnormal motion perception caused by physiological or pathological factors, negative transfer due to small sample size, and catastrophic forgetting caused by non-stationary data distribution. Based on graph models, domain adaptation, and continual learning theory, I proposed robust denoising methods for human motion perception, domain adaptation methods for human motion assessment, and continual learning methods for human motion assessment. These were validated in two real-world applications: grasping training in microgravity and movement assessment for juvenile dermatomyositis. The three topics are closely connected and progressively layered: the first provides high-quality data for the latter two, and the third builds upon the second while considering real-world application needs.

Education

PhD Candidate, Beihang University, Beijing, China
Computer Application Technology, State Key Lab of VR Technology and Systems — 2020 – 2025
Advisor: Prof. Xiaohui Liang

Visiting Student, Durham University, Durham, UK — Feb. 2024 – Aug. 2024
Collaborating Advisors: Prof. Hubert P. H. Shum, Dr. Frederick W. B. Li

Bachelor, Henan Normal University, Henan, China
Major: Computer Science and Technology — 2016 – 2020
Minor: English — 2017 – 2020

Exchange Student, Frankfurt University of Applied Sciences, Frankfurt, Germany — June 2019
Collaborating Advisor: Prof. Jürgen Jung

Academic Activities and Services

- Delivered oral presentations at several top conferences in computer vision and virtual reality, including:

Conference	VR 2025	ECCV 2024	VR 2023	ISMAR 2023	ISMAR 2021
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- Co-supervised multiple Master's and PhD students in China and UK, including:

Name (YY–YY)	Degree	University	Co-supervisor	Research Field
Ruisheng Han (24–28)	PhD	Durham	Prof. Hubert	Co-authored CVPRW
Ruizhi Cai (22–25)	Master's	Beihang	Prof. Liang	AQA, co-authored TVCG, IJCAI
Zikai Hao (22–25)	Master's	Beihang	Prof. Liang	Pose estimation, co-authored TVCG
Chen Chen (21–24)	Master's	Beihang	Prof. Liang	Hand-object interaction, co-authored ISMAR'23
Zhiyuan Cheng (20–22)	Master's	Beihang	Prof. Liang	Pose estimation, co-authored ISMAR'21
Yulei Zhong (20–22)	Master's	Beihang	Prof. Liang	Action recognition

- Main student participant and contributor in an NSFC project (No. 62272019);
- Responsible for the reception and arrangement of Dr. Frederick W. B. Li from Durham University during his visit to Beihang University (June 2023).
- Served as a reviewer for journals and conferences in the field of computer vision, including TCyb, TCSVT, PR, ICLR, VR, ISMAR, ACM MM, and BMVC.

Main First-Author Publications

- Published Papers:

[1] **K. Zhou**, L. Wang, X. Zhang, H. P. Shum, F. W. Li, J. Li, and X. Liang, "Magr: Manifold-aligned graph regularization for continual action quality assessment," in *European Conference on Computer Vision (ECCV)*, vol. 15069, 2024, pp. 375–392. DOI: 10.1007/978-3-031-73247-8_22. (GitHub | YouTube | THU A | **Oral presentation at top computer vision conference, Top 2.3% of conference** | *Proposes continual graph regularization to address the dual challenges of non-stationary generalization and privacy protection in action quality assessment.*)

[2] **K. Zhou**, R. Cai, Y. Ma, Q. Tan, X. Zhang, J. Li, S. Jin, and X. Liang, "A video-based augmented reality system for human-in-the-loop muscle strength assessment of juvenile dermatomyositis," *IEEE Transactions on Visualization and Computer Graphics (TVCG)*, vol. 29, no. 5, pp. 2456–2466, 2023. DOI: 10.1109/TVCG.2023.3247092. (YouTube | YouTube | CCF A | CAS 1 TOP | IF 6.5 | **Top-tier journal in computer graphics, oral presentation at top VR conference VR 2023, high-scoring paper recommended for publication in TVCG, Top 10% of conference** | *Combines augmented reality to address trust issues in deep learning models for medical rehabilitation. Experiments at Capital Institute of Pediatrics show that the system improved doctors' diagnostic accuracy by 4.99% and efficiency by 20%.*)

[3] **K. Zhou**, Z. Hao, L. Wang, and X. Liang, "Adaptive score alignment learning for continual perceptual quality assessment of 360-degree videos in virtual reality," *IEEE Transactions on Visualization and Computer Graphics (TVCG)*, vol. 31, no. 5, pp. 2880–2890, 2025. DOI: 10.1109/TVCG.2025.3549179. (GitHub | CCF A | CAS 1 TOP | IF 6.5 | **Top-tier journal in computer graphics, oral presentation at top VR conference VR 2025, high-scoring paper recommended for publication in TVCG** | *Proposes a continual video quality assessment model based on compressed video replay to address storage and computational constraints on VR devices.*)

[4] **K. Zhou**, H. P. Shum, F. W. Li, X. Zhang, and X. Liang, "Phi: Bridging domain shift in long-term action quality assessment via progressive hierarchical instruction," *IEEE Transactions on Image Processing (TIP)*, vol. 34, pp. 3718–3732, 2025. DOI: 10.1109/TIP.2025.3574938. (GitHub | CCF A

CAS 1 TOP IF 13.7 | *A follow-up to IJCAI 2024, proposing a domain shift...nd feature adaptation outperforms task reconstruction methods.*)

[5] **K. Zhou**, H. P. Shum, F. W. Li, and X. Liang, "Multi-task spatial-temporal graph auto-encoder for hand motion denoising," *IEEE Transactions on Visualization and Computer Graphics (TVCG)*, vol. 30, no. 1, pp. 6754–6769, 2024. DOI: 10.1109/TVCG.2023.3337868. (| | CCF A CAS 1 TOP IF 6.5 | **Top journal in computer graphics** | *An extension of ISMAR 2021, introducing a motion prediction task to address the oversmoothing problem in denoising results.*)

[6] **K. Zhou**, J. Li, R. Cai, L. Wang, X. Zhang, and X. Liang, "Cofinal: Enhancing action quality assessment with coarse-to-fine instruction alignment," in *International Joint Conference on Artificial Intelligence (IJCAI)*, 2024, pp. 1771–1779. DOI: 10.24963/ijcai.2024/196. (CCF A | *Proposes a coarse-to-fine task alignment method to address domain shift in action quality assessment.*)

[7] **K. Zhou**, Y. Ma, H. P. H. Shum, and X. Liang, "Hierarchical graph convolutional networks for action quality assessment," *IEEE Transactions on Circuits and Systems for Video Technology (TCSVT)*, vol. 33, no. 12, pp. 7749–7763, 2023. DOI: 10.1109/TCSVT.2023.3281413. (| CCF B CAS 1 TOP IF 8.3 | *Proposes a hierarchical graph network to address the insufficient sensitivity of action quality assessment models to subtle action differences.*)

[8] **K. Zhou**, Z. Cheng, H. P. Shum, F. W. Li, and X. Liang, "Stgae: Spatial-temporal graph auto-encoder for hand motion denoising," in *IEEE International Symposium on Mixed and Augmented Reality (ISMAR)*, 2021, pp. 41–49. DOI: 10.1109/ISMAR52148.2021.00018. (| Core A* CCF B | **Oral presentation, top-tier conference in augmented reality** | *Proposes a spatial-temporal graph model to address motion perception anomalies in augmented reality caused by user fatigue or physiological factors.*)

[9] **K. Zhou**†, C. Chen†, Y. Ma, Z. Leng, H. P. H. Shum, F. W. B. Li, and X. Liang, "A mixed reality training system for hand-object interaction in simulated microgravity environments," in *IEEE International Symposium on Mixed and Augmented Reality (ISMAR)*, 2023, pp. 167–176. DOI: 10.1109/ISMAR59233.2023.00031. (| | Core A* CCF B | **Oral presentation, top-tier conference in augmented reality** | *Combines augmented reality technology to propose an object grasping system in simulated microgravity, providing the public with a low-cost, highly immersive space experience tool.*)

[10] L. Chen†, **K. Zhou**†, J. Jing, H. Fan, and J. Li, "Solution path algorithm for twin multi-class support vector machine," *Expert Systems with Applications*, vol. 210, p. 118 361, 2022. DOI: 10.1016/j.eswa.2022.118361. (| CCF C CAS 1 TOP IF 7.5 | *Undergraduate thesis extension work proposing a solution path algorithm for multi-class TSVM, enabling continuous tracking of the optimal solution as the regularization parameter changes and providing the complete regularization path.*)

[11] **K. Zhou**, Q. Zhang, and J. Li, "Tsvmpath: Fast regularization parameter tuning algorithm for twin support vector machine," *Neural Processing Letters*, vol. 54, pp. 1–26, 2022. DOI: 10.1007/s11063-022-10870-1. (| CCF C CAS 4 IF 2.6 | **Excellent Undergraduate Thesis Award in Henan Province** | *Undergraduate thesis work that rapidly updates the twin SVM model along the solution path of the regularization parameter, enabling efficient hyperparameter tuning and model selection.*)

[12] **K. Zhou**, J. Fan, H. Fan, and M. Li, "Secure image encryption scheme using double random-phase encoding and compressed sensing," *Optics & Laser Technology*, vol. 121, p. 105 769, 2020. DOI: 10.1016/

j.optlastec.2019.105769. (| CAS 2 TOP IF 4.6 | *Proposes a secure and reliable image encryption algorithm by combining compressed sensing with double random-phase encoding.*)

[13] **K. Zhou**, M. Xu, J. Luo, H. Fan, and M. Li, "Cryptanalyzing an image encryption based on a modified henon map using hybrid chaotic shift transform," *Digital Signal Processing*, vol. 93, pp. 115–127, 2019. DOI: 10.1016/j.dsp.2019.07.013. (| CAS 3 IF 2.9 | *Effectively breaks an image encryption algorithm based on a modified Henon map and hybrid chaotic shift transform.*)

➠ Under Review

[14] **K. Zhou**, R. Cai, L. Wang, H. P. H. Shum, and X. Liang, "A comprehensive survey of action quality assessment: Method and benchmark," *arXiv preprint arXiv:2412.11149*, 2024. DOI: 10.48550/arXiv.2412.11149. (| CCF B CAS 1 TOP IF 7.6 | **Submitted to Pattern Recognition (PR)** | *Systematically reviews AQA methods and benchmarks, establishes a unified taxonomy and evaluation protocol, compiles datasets and metrics, and highlights key challenges and future directions.*)

[15] **K. Zhou**†, R. Cai†, X. Wang†, J. Li, and X. Liang, "Two-stage multi-modal fusion with adaptive alignment for muscle strength assessment of juvenile dermatomyositis," *IEEE Transactions on Pattern Analysis and Machine Intelligence (TPAMI)*, 2025. (CCF A CAS 1 TOP IF 18.6 | *Proposes a two-stage multi-modal adaptive alignment method that effectively integrates skeleton, image, optical flow, and textual information to enhance the robustness of muscle strength assessment for juvenile dermatomyositis.*)

Major Honors and Awards

2025.07 Beijing Outstanding Graduate
2025.03 No. 9 Company Special Scholarship, Beihang University
2024.11 National Scholarship (PhD)
2024.06 Beihang Academic Innovation Achievement Award
2020.12 Henan Province Outstanding Bachelor's Thesis
2020.12 National Second Prize, China Graduate Mathematical Modeling Competition
2019.11 National Scholarship (Undergraduate)
2019.05 Youth May Fourth Medal, Henan Normal University
2018.12 National First Prize, China Undergraduate Mathematical Contest in Modeling