Hao Ai

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EDUCATION

Tsinghua University, Beijing, China **September 2018- June 2021**
M.S. in Electronic Engineering (supervised by Prof. Qingmin Liao)
Main Course: Stochastic Processes, Pattern Recognition, Statistical Signal Processing, Digital Image Processing, etc.
GPA: 3.29/4.0
Research Focus: Face recognition, image classification, and representation learning
Master Thesis: Feature Based Loss Functions on Image Classification Task with CNN Approaches (Excellent Graduation Thesis candidate)

Beijing Jiaotong University,Beijing, China **September 2014- June 2018**
B.S. in Communication Engineering (work with Prof. Yuchun Guo)
Main Course: Communications Principle, Linear Algebra, Calculus, Digital Signal Processing, etc.
Bachelor Thesis: Research on Relationships between Customer Comments and Sales on E-commerce Platform (*based on machine learning*)

RESEARCH INTEREST

I am deeply passionate about signal processing, deep learning, and computer vision. The world of images, serving as two-dimensional snapshots of reality, has always fascinated me. I am particularly intrigued by the prospect of extracting three-dimensional insights from these flat pictures. Lately, my focus has been on exploring 360° images captured using innovative camera sensors. I am enthusiastic about merging these 360° images with dynamic 3D data, such as point clouds or meshes. I envision harnessing this fusion for impactful research, with potential applications ranging from robotics to self-driving vehicles. Furthermore, inspired by the success of large-scale vision models and large-scale language models, I am keen on investigating their potential for specific vision tasks.

SKILLS

Proficient in deep learning frameworks such as PyTorch and TensorFlow, I also possess valuable experience in MATLAB. Moreover, during my industry journey, I have studied JAVA.

PUBLICATIONS

H. Ai, L. Wang. Elite360D: Towards Efficient 360 Depth Estimation via Semantic- and Distance-Aware Bi-Projection Fusion. *CVPR 2024*

H. Ai, Z. Cao, H. Lu, C. Chen, J. Ma, P. Zhou, T. Kim, P. Hui, L. Wang. Dream360: Diverse and Immersive Outdoor Virtual Scene Creation via Transformer-Based 360 Image Outpainting. *IEEE VR 2024* & *IEEE Transactions on Visualization and Computer Graphics*

H. Ai, Z. Cao, YP. Cao, Y. Shan, L. Wang. HRDFuse: Monocular 360° Depth Estimation by Collaboratively Learning Holistic-With-Regional Depth Distributions. *CVPR 2023*

Z. Cao, **H. Ai**, YP. Cao, Y. Shan, X. Qie, L. Wang. OmniZoomer: Learning to Move and Zoom in on Sphere at High-Resolution. *ICCV 2023*

H. Ai, Q. Liao, Y. Chen, J. Qian. Gaussian mixture distribution makes data uncertainty learning better. *IEEE International Conference on Automatic Face and Gesture Recognition 2021*

B. Wang, X. Tang, **H. Ai**, Y. Li, W. Xu, X. Wang, D. Han. Obstructive Sleep Apnea Detection Based on Sleep Sounds via Deep Learning. *Nature and Science of Sleep*

Z. Cao, **H. Ai**, L Wang. 360° High-Resolution Depth Estimation via Uncertainty-aware Structural Knowledge Transfer. *IEEE Transactions on Artificial Intelligence*

UNDER REVIEW

H. Ai*, Z. Cao*, J. Zhu, H. Bai, Y. Chen, L Wang. Deep Learning for Omnidirectional Vision: A Survey and New Perspectives. *Arxiv*

RESEARCH EXPERIENCE

Research assistant in AI Thrust, HKUST(GZ) **May 2022-Present**
& **Intership in Tencent ARCLab** with Dr. Yan-Pei Cao **May 2022- February 2023**
Worked on *HRDFuse, Elite360D, Dream360* as the first author, *OmniZoomer* as the second author and *Deep Learning for Omnidirectional Vision* as the co-first author (first place).

- (*In Tencent ARCLab*) Defined the research problem of fully leveraging the multiple projections of 360° images, proposed **HRDFuse** to combine holistic contextual information and regional structural information, designed and conducted experiments, analyzed the results, and wrote the paper.
- Further investigated bi-projection fusion for 360° depth estimation and introduced **Elite360D**. This approach utilizes ERP images and an icosahedron projection point set as inputs for an efficient fusion model.
- Inspired by auto-regressive transformer-based generative models, we proposed **Dream360**, a generative model specifically designed for 360 images. Dream360 learns a sphere-specific codebook, outpaints freely masked panoramas, and refines the generated outputs. I designed and conducted the experiments, analyzed the results, and wrote the paper.
- Contributed to the idea of OmniZoomer, combining the Mobius transformation and 360° image super-resolution to produce HR and high-quality ODIs with the flexibility to move and zoom in to the object of interest, and wrote the paper.
- Proposed the first systematic and comprehensive review and analysis of the recent progress in deep learning methods for omnidirectional vision with my partners. We analyzed over 200 high-quality papers and provided an insightful discussion of the challenges and open problems.

Tsinghua VIP Lab with Prof. Qingmin Liao **September 2018- June 2021**
Intership in Ping An Technology **March 2020- January 2021**
Worked on *Obstructive Sleep Apnea detection* project and *Robust Face Recognition* project.

- Worked with an undergraduate student of computer science and a doctor of Medicine to accomplish the Obstructive Sleep Apnea detection, which is a sub-project of a National Key Research and Development Program of China.
- Contributed to the research ideation by extending the object detection method for images into the 1-D sound signals, designed and ran the experiments, and wrote the paper.
- (*In Ping An Technology*) Proposed a VAE model based on multivariate Gaussian mixture distributions for face recognition, designed and ran the experiments, and wrote the paper. The performance of proposed model has proven to be significantly improved on multiple benchmarks.

INDUSTRY EXPERIENCE

Algorithms Engineer in Beijing Research Institute of Huawei Technology Co., Ltd
July 2021-March 2022

- Designed and developed algorithms for autonomous driving network (ADN), which introduces the power of artificial intelligence into the management of communication networks for more effectively and efficiently detecting and solving the network error.