

XIN CAI

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🎓 EDUCATION

The Chinese University of Hong Kong, Hong Kong, China 2023 – Present

Ph.D. in Information Engineering, expected June 2027 **Supervisor: Prof. Tianfan Xue**

Institute of Computing Technology, Chinese Academy of Sciences, Beijing, China 2020 – 2023

M.Eng. in Applied Computer Technology **Supervisor: Prof. Shiguang Shan**

University of Chinese Academy of Sciences (UCAS), Beijing, China 2016 – 2020

B.S. in Computer Science and Technology **Cumulative GPA: 3.90/4.00 Rank: 2/68**

🔍 RESEARCH INTERESTS

Computational Imaging and Photography: Image reconstruction; Image and video processing

3D Computer Vision: 3D reconstruction, rendering and generation

Data-Efficient Machine Learning: Weakly- and Self-supervised learning; Transfer learning

Applied Computer Vision Techniques: Gaze estimation; Emotion recognition

👥 RESEARCH PROJECTS

Robust Privacy-Preserving Face Verification with Lensless Camera June. 2023 – Nov. 2023

First Author Supervisor: Prof. Tianfan Xue

Developed a lensless imaging system capable of conducting robust face verification directly from optically encoded sensor captures. The system jointly optimizes the optical mask used in lensless imaging and the deep learning model for face verification.

- Proposed an end-to-end optimization-based face verification system using lensless cameras, which brings improvements in privacy, accuracy, and speed when compared to conventional two-stage ‘reconstruct-and-verify’ processes for lensless face verification.
- Proposed a novel face center alignment scheme for lensless setup, an augmentation curriculum to build robustness against variations, and a knowledge distillation method to smooth optimization.
- Compared with traditional RGB-based methods, the lensless face verification system provides inherent hardware-level privacy protections within small, efficient, and inexpensive devices.

Real-Time Point-of-Gaze Estimation System Sep. 2020 – Mar. 2023

Primary Contributor Supervisor: Prof. Shiguang Shan and Prof. Jiabei Zeng

Developed a system that estimates the Point-of-Gaze on a 24-inch screen according to the users’ face images.

- Developed the system by first estimating the gaze direction and then converting the direction to the Point-of-Gaze according to the screen-camera relationship, achieving an average error of 30 mm after the calibration.
- Measured the screen-camera relationship by calibrating the camera’s intrinsic parameters using Zhang’s method and the camera’s extrinsic parameters using a mirror-based method.
- Proposed a gaze estimation method using high-resolution features and a multi-channel attention mechanism.
- Proposed an unsupervised source-free domain adaptation gaze estimation method based on sample and model uncertainty reduction.

Self-Supervised Eye Semantic Segmentation Jun. 2021 – Sep. 2021

First Author Supervisor: Prof. Shiguang Shan and Prof. Jiabei Zeng

Proposed a self-supervised eye segmentation method leveraging weak empirical prior on the eye shape.

- Designed a symmetrical auto-encoder architecture to learn disentangled representations of eye appearance and eye shape in a self-supervised manner.
- Segmented eye images into meaningful parts leveraging unlabelled images and unpaired eye landmarks.

- Achieved comparable eye segmentation performance with the state-of-the-art supervised methods.

AI-Aided Screening System for Autism Spectrum Disorder (ASD) Sep. 2021 – Mar. 2023

Primary Developer, in collaboration with Prof. Jiabei Zeng Supervisor: Prof. Shiguang Shan

Built an ASD screening system according to the children's point-of-gaze and facial behaviors.

- Developed the primitive system with Tobii Gaze Tracker and four cameras.
- Collected data using the primitive system, including ~160 children's facial expressions and point of gaze on the screen when they watched specially designed materials.
- Trained machine learning models to distinguish ASDs from typically developed children according to their facial expression and gaze features.

PUBLICATIONS

- **X. Cai**, et al. "Robust Privacy-Preserving Face Verification with an End-to-End Optimized Lensless System." *CVPR submission*, 2023.
- **X. Cai**, J. Zeng, S. Shan, and X. Chen, "Source-free Adaptive Gaze Estimation with Uncertainty Reduction," The IEEE / CVF Computer Vision and Pattern Recognition Conference (CVPR), 2023.
- **X. Cai**, J. Zeng and S. Shan, "Landmark-aware Self-supervised Eye Semantic Segmentation," IEEE International Conference on Automatic Face and Gesture Recognition (FG), 2021.
- **X. Cai**, B. Chen, J. Zeng, et al. "Gaze Estimation with an Ensemble of Four Architectures." arXiv preprint arXiv:2107.01980, 2021. (Technical report for the winner solution in ETH-XGaze Gaze Estimation Challenge@CVPR 2021)

HONORS AND AWARDS

Academy Scholarship of University of Chinese Academy of Science	2017, 2018 and 2019
National Encouragement Scholarship	2017, 2018 and 2019
The Tang Lixin Academic Excellence Scholarship	Jun. 2020
<i>1st Prize</i> , Award on ETH-XGaze Challenge	Jun. 2021
Merit Student of University of Chinese Academy of Sciences	2018, 2021 and 2023
Postgraduate Studentship	Mar. 2023

SKILLS

- Programming Languages: Python == C > C++
- Framework: PyTorch > TensorFlow
- Development: FFmpeg, Qt, Git