

Jiazhang Wang

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Education

McCormick School of Engineering, Northwestern University, USA
Ph.D. in Electrical and Computer Engineering

09/2019 - 06/2024

The Fu Foundation School of Engineering and Applied Science, Columbia University, USA
MS in Electrical Engineering

09/2017 - 05/2019

**School of Electrical and Electronic Engineering,
Huazhong University of Science and Technology (HUST), China**
B.Eng. in Electrical Engineering and Automation

09/2013 - 06/2017

Research Interests

My research interests lie at the intersection of optical metrology, machine vision, and computational photography. I aim to develop the next generation of 3D imaging sensors by bridging the gap between high-precision optical metrology techniques and the broad applicability of computer vision methods.

During my Ph.D. and postdoctoral training, I developed a series of eye-tracking techniques using deflectometry, an optical metrology approach. This marked the first time such a principle was applied to eye tracking. This novel method has significant potential for applications in AR/VR, psychology, and medical diagnostics. In addition, I explored integrating the optical metrology with computer vision techniques. For example, by combining deflectometry with shape-from-polarization—a computer vision-based 3D imaging principle, I developed a highly accurate and versatile 3D sensor capable of measuring specular surfaces, a long-standing challenge in both optical metrology and computer vision. Moreover, I designed a novel 3D sensor based on event cameras and active 3D imaging principles to measure mixed reflectance scenes, while state-of-the-art 3D imaging methods (e.g. ToF, active triangulation) are typically optimized for either diffuse or specular reflection.

In my future faculty career, I plan to continue developing robust and portable 3D sensors for a variety of applications, including VR/AR, medical imaging, industrial inspection, and cultural heritage preservation. I also intend to integrate my understanding of physical models behind various 3D imaging principles with modern neural networks to drive the next generation of 3D vision systems. Additionally, I am eager to create datasets enriched with meaningful physical information to support research in this field. Through active discussions with my advisor Prof. Willomitzer, the expert of coherent imaging principles (e.g., holography, interferometry, and optical coherence tomography), I have identified exciting opportunities to integrate my expertise in incoherent imaging approaches with coherent methods. This integration could address high-end challenges such as imaging through scattering media and reconstructing scenes around corners, pushing the boundaries of 3D imaging technologies.

Professional Experience

Wyant College of Optical Sciences, University of Arizona, Tucson, AZ, USA
Postdoctoral Research Associate with Prof. Florian Willomitzer

06/2024 - Present

McCormick School of Engineering, Northwestern University, Evanston, IL, USA
Research Assistant with Prof. Oliver Cossairt and Prof. Florian Willomitzer

09/2019 - 06/2024

Meta Reality Lab, Redmond, WA, USA
Research Intern with Dr. Yatong An

06/2023 - 09/2023

OPPO US Research Institute, Bellevue, WA, USA
Research Intern with Prof. Guojun Qi

03/2022 - 09/2022

Projects

Advanced 3D Imaging of Shiny Objects using Deflectometry and Polarization

09/2023 - Present

- Develop an advanced 3D imaging method for measuring shiny and specular objects
- Solve the normal-depth ambiguity problem of single-camera Deflectometry
- Solve the orthographic projection assumption of Shape from Polarization

Deflectometric Eye Tracking using Deep Learning

09/2023 - Present

- Build a virtual digital twin setup to generate the training dataset
- Propose to use correspondence map as the input rather than intensity image
- Implement real experiment

3D Metrology for Additive Manufacturing

02/2023 - Present

- Develop the high-accuracy 3D imaging system for shiny manufacturing parts
- Develop a polarization-guided single-shot triangulation 3D imaging system

Event-based Motion-Robust Shape Estimation for Mixed Reflection Scenes

09/2022 - 05/2024

- Develop the high accuracy and fast speed 3D reconstruction with Event-Triangulation sensor
- Develop the algorithm for measuring objects with mixed-reflectance
- Build the Event-Triangulation measurement prototype

Accurate Eye Tracking using Single-shot Stereo Deflectometry

07/2020 - 09/2023

- Develop the algorithm for estimating the eye gaze direction with single-shot fringe projection.
- Develop a novel calibration method for the stereo Deflectometry system within the small field of view
- Design and build the experimental prototype.

Optimization-based Eye Tracking using Inverse Rendering

07/2020 - 03/2023

- Develop the eye tracking algorithm using differentiable rendering
- Develop differentiable Deflectometry Rendering for 3D shape reconstruction
- Build the experimental prototype and conduct the experiment.

Honors and Awards

Emil Wolf Outstanding Student Paper Finalist, 2024 OPTICA Frontiers in Optics (FiO)

Postdoctoral Travel Grant, the University of Arizona, 2024

Best Student Paper, 2024, International Conference on Optics-photonics Design & Fabrication

SPIE Student Conference Grant, 2024 SPIE Optics + Photonics

OSA Student Paper Award Finalist, 2021 OSA Imaging and Applied Optics Congress

Full Publication List (Author order by contribution)

Under Revision and related preprints:

J. Wang, T. Wang, B. Xu, O. Cossairt, and F. Willomitzer, “Accurate Eye Tracking from Dense 3D Surface Reconstructions using Single-Shot Deflectometry”, *arXiv preprint arXiv:2308.07298*, 2023 (**Accepted in Nature Communication, in production process**)

J. Wang, O. Cossairt, and F. Willomitzer, “3D Imaging of Complex Specular Surfaces by Fusing Polarimetric and Deflectometric Information”, *arXiv preprint arXiv:2406.01994*, 2024. (**Provisionally Accepted in OPTICA**)

A. Dashpute, **J. Wang****, J. Taylor, O. Cossairt, A. Veeraraghavan, and F. Willomitzer, “Event-based Motion-Robust Shape Estimation for Mixed Reflectance Scenes”, *arXiv preprint arXiv:2311.09652*, 2023. (**Under Revision in Nature Communication, **corresponding Author**)

Published Journal

T. Wang, **J. Wang****, O. Cossairt, and F. Willomitzer, “Differentiable Deflectometric Eye Tracking,” *IEEE*

Transactions on Computational Imaging 10 (2024): 888-898. (**corresponding Author)

H. Liu, S. Fang, Z. Zhang, D. Li, K. Lin and **J. Wang**, "MFDNet: Collaborative Poses Perception and Matrix Fisher Distribution for Head Pose Estimation," *IEEE Transactions on Multimedia* 24 (2021): 2449-2460.

H. Liu, C. Zheng, D. Li, X. Shen, K. Lin, **J. Wang**, "EDMF: Efficient Deep Matrix Factorization with Review Feature Learning for Industrial Recommender System," *IEEE Transactions on Industrial Informatics* 18, no. 7 (2021): 4361-4371.

H. Liu, C. Zheng, D. Li, Z. Zhang, K. Lin, X. Shen, NN. Xiong, **J. Wang**, "Multi-perspective social recommendation method with graph representation learning", *Neurocomputing* 468 (2022): 469-481.

Conference Proceedings

J. Wang*, T. Wang*, J. Choi*, O. Cossairt, and F. Willomitzer, "Deflectometric Eye-tracking on Human Eyes", *In Frontiers in Optics*, pp. FTu6B-3. Optica Publishing Group, 2024. (Emil Wolf Outstanding Student Paper Competition Finalist, *contributed equally)

J. Wang, O. Cossairt, and F. Willomitzer, "Polarization-guided Deflectometry", *In Interferometry and Structured Light 2024*, vol. 13135, pp. 42-45. SPIE, 2024.

J. Taylor, **J. Wang**, and F. Willomitzer, "Radiometric calibration of active 3D imaging setups using superquadric fitting", *In Interferometry and Structured Light 2024*, vol. 13135, pp. 88-91. SPIE, 2024.

J. Choi, **J. Wang**, T. Wang, and F. Willomitzer. "Accurate Eye-Tracking from Deflectometric Information using Deep Learning", *International Conference on Optics-photonics Design & Fabrication*, vol 13258, 1325801-61 SPIE, 2024. (Best Student Paper Award)

J. Taylor, **J. Wang**, and F. Willomitzer, "On-the-Fly Radiometric Calibration of Active 3D Imaging Setups using Superellipse Fitting", *In Frontiers in Optics*, pp. FTu6D-3. Optica Publishing Group, 2023.

J. Wang*, T. Wang*, B. Xu, O. Cossairt, and F. Willomitzer, "Accurate and Fast VR Eye-Tracking using Deflectometric Information", *In Computational Optical Sensing and Imaging*, pp. CTh2B-5. Optica Publishing Group, 2023. (*contributed equally)

J. Wang, B. Xu, O. Cossairt, and F. Willomitzer, "Easy and Flexible Calibration Approach for Deflectometry-based VR Eye-Tracking systems", *In Computational Optical Sensing and Imaging*, pp. CTh5C-1. Optica Publishing Group, 2022.

J. Wang*, B. Xu*, T. Wang, W. Lee, M. Walton, N. Matsuda, O. Cossairt, F. Willomitzer, "VR Eye-Tracking using Deflectometry", *In Computational Optical Sensing and Imaging*, pp. CF2E-3. Optica Publishing Group, 2021. (OSA Student Paper Award Finalist, *contributed equally)

Patents

J. Wang, F. Willomitzer, *Method and system for eye tracking using structured light*, USA, pending, 2024

J. Wang, F. Willomitzer, *Polarization guided deflectometry*, USA, pending 2024

Conference Talks

"Deflectometric Eye-tracking on Human Eyes", *Frontiers in Optics + Laser Science*, Denver, CO, USA, Sep 2024

"Polarization-guided Deflectometry", *SPIE Optics + Photonics*, San Diego, CA, USA, 2024

"Accurate and Fast VR Eye-Tracking using Deflectometric Information", *OSA Imaging and Applied Optics Congress*, Boston, MA, USA, 2023

"Precise VR Eye Tracking using Single-Shot Deflectometry", *Annual conference of the German Society of Applied Optics (DGaO)*, Berlin, Germany, 2023

"Easy and Flexible Calibration Approach for Deflectometry-based VR-Eye tracking systems", *OSA Imaging Congress*, Vancouver, BC, Canada, 2022

"VR Eye-Tracking using Deflectometry", *OSA Imaging Congress*, Virtual Event, 2021

Teaching Experience

Delivered two lectures in "OPTI 596: Computational Imaging and Machine Vision", the University of Arizona, 2024.

Delivered one lecture in "OPTI 596: Computational Imaging and Machine Vision", the University of Arizona, 2023.

Delivered one lecture in "CS331: Introduction to Computational Photography", Northwestern University, 2022.

Teaching assistant, “EE495: Computational Photography Seminar”, Northwestern University, 2021

Teaching assistant, “CS331: Introduction to Computational Photography”, Northwestern University, 2020, 2022

Services

Reviewer of venues:

Light: Science & Applications

OPTICA

SIGGRAPH

Information processing and management

Neurocomputing

Mentor of students:

James Taylor (Ph.D., University of Arizona)

Jiwon Choi (Ph.D., University of Arizona)

Tianyi Wang (MS, University of Arizona)

Quan Zhang (MS, Northwestern University)

Tianfu Wang (BS, Northwestern University)