Yiyang Chen

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Education

Washington University in St. Louis St. Louis, MO, USA
PhD in *Imaging Science* Sept 2021 - present

- **Research Advisor**: Dr. Matthew Lew
- **Dissertation**: Multi-dimensional Single Molecule Nanoscopy to Elucidate the Structure and Conformational Dynamics of Cell Membrane Proteins
- **Dissertation Committee**: Dr. Matthew Lew (chair); Dr. Michael Vahey; Dr. David Piston; Dr. Joseph O'Sullivan; Dr. Christy Landes
- **Coursework**: Fundamentals and Applications of Modern Optical Imaging, Machine Learning, Large-scale Optimization for Data Science, Detection and Estimation Theory, Theoretical Imaging Science, ...

Nankai University Tianjin, China
BSc (honor) in *Physics*, Poling Class of Physics Sept 2017 - Jun 2021

- **Research Advisor**: Dr. Leiting Pan
- **Thesis**: The Study of Deformability of Human Erythrocyte Based on Microfluidics
- **Coursework**: Electrodynamics, Optics, Quantum Mechanics, Mathematical Methods in Physics, Introduction to Biophysics, Molecular Biophysics, Biomedical Physics, ...

Publications

* equal contribution

Peer-Reviewed Journal Articles

[1] **Y. Chen**, Y. Qiu, and M. D. Lew, Resolving the orientations of and angular separation between a pair of dipole emitters. *Physical Review Letters* **134**, 093805 (2025).

Preprints and Manuscripts in Preparation

[3] **Y. Chen***, Y. Qiu*, M. D. Lew, Single Fluorogens and Orientation-Localization Microscopy for Quantifying Chemical and Biomolecular Dynamics at the Nanoscale. In review at *Accounts of Chemical Research*.

[2] X. Li*, **Y. Chen***, et al, DeepSMOLM3D: a deep learning approach for sequential estimation of 3D localization and 3D orientation in single-molecule microscopy. *Manuscript in preparation*.

[1] E. Gillett, S. Chatterjee*, J. Chatterjee*, N. Kovalenko, C. Xu, D. Fan, **Y. Chen**, Y. Qiu, J. Miao, V. Nelavoy, M. D. Lew, M. P. Backlund, and C. F. Landes, Fused deep learning enables 6D single-molecule localization in polarization-resolved microscopy. In review at *Methods and Applications in Fluorescence*.

Conference Proceedings

[1] **Y. Chen**, Y. Qiu, and M. D. Lew, Combining Excitation and Emission Modulation Resolves the Angular Separation between a Pair of Dipole Emitters. In *Optica Biophotonics Congress 2025*, Technical Digest Series (Optica Publishing Group, 2025), paper NM1C.4.

Research Experiences

Single-Molecule Orientation Localization Microscopy (SMOLM): Fundamental Limits, Computational Methods, and Biological Imaging Applications May 2022 – present

Graduate Research Assistant, Lew Lab, Washington University in St. Louis

Theoretical Modeling & Analysis

- Discovered the fundamental degeneracy and limits for distinguishing a pair of spatially overlapping dipole emitters from rotating single molecules; derived the mathematical necessity of measuring fourth-order orientation moments.
- Developed a combined excitation polarization and emission dipole-spread function (DSF) modulation to improve the precision of angular separation measurements by 200–400% and centroid orientation by 50% over state-of-the-art methods.
- (Ongoing) Investigating fourth-order-moment measurements to uplift parameter space, aiming to resolve higher-order orientational dynamics.

Computational Imaging & Algorithm Development

- Engineered DSFs by maximizing Fisher information using convex optimization approaches for targeted orientation

regimes.

- Designed a physics-informed SMOLM data generation pipeline to architect high-fidelity training and validation datasets for DeepSMOLM3D, ensuring the network accurately modeled complex 6D imaging parameters.
- Conducted comprehensive simulation studies (varying SNR, molecule density, etc.) and experimental trials on cell membrane imaging to demonstrate the superior accuracy, precision, and reconstruction speed over the traditional maximum-likelihood estimation algorithm under complicated imaging scenarios.

Optical Systems & Biophysical Applications

- Executed full optical alignment and calibration of a dual-polarization 4f imaging system incorporating a Liquid Crystal Spatial Light Modulator (SLM) for precise phase modulation.
- Performed PAINT single-molecule imaging of supported lipid bilayers (SLB) and cell membranes using membrane-sensitive fluorogenic fluorophores, demonstrating different binding dynamics of different fluorophores on membrane structures.
- (Ongoing) Optimizing protein-tag-based labeling for robustly measuring cell membrane orientation and rotational dynamics.

Study of Human Red Blood Cell (hRBC) Membrane Characteristics Based on Microfluidics and Single-Molecule Localization Microscopy Apr 2019 – Jun 2021

Undergraduate Research Assistant, Advisor: Dr. Leiting Pan, School of Physics, Nankai University

- Quantified hRBC deformability by measuring the speed of cells traveling through narrow microfluidic channels.
- Designed and simulated a novel microfluidic ratchet chip using COMSOL Multiphysics to sort hRBCs based on age-related deformability.
- Analyzed hRBC actin-spectrin network and CD47 diffusivity on hRBC membranes using single-molecule localization microscopy (SMLM).

Conference Presentations

[3] "**Combining Excitation and Emission Modulation Resolves the Angular Separation Between a Pair of Dipole Emitters**", oral. *Optica Biophotonics Congress: Optics in the Life Sciences*, Coronado, CA, April 2025

[2] "**Resolving the Orientations of and Separation between an Overlapping Pair of Dipole Emitters**", poster. *Gordon Research Conferences: Single Molecule Approaches to Biology*, Newry, ME, July 2024

[1] "**Immunofluorescent Biomarkers for Distinguishing Cell Phenotypes in Zebrafish Somitogenesis and Autonomous Cellular Oscillators**", poster. *APS March Meeting 2020*, Denver, CO, March 2020 (online)

Honors and Awards

Excellence Award, China National University Student Innovation & Entrepreneurship Development Program — Mar 2021

First Prize, Nankai Physics Tournament — May 2018

Poling Scholarship, Nankai University — Oct 2017

Skills

Programming: MATLAB, Python (PyTorch, Tensorflow, SciPy, ...), Wolfram Mathematica

Software: ImageJ, COMSOL Multiphysics, Origin, PyMOL, Zemax OpticStudio

Laboratory

- Optical Lab: optical system design, construction, and alignment; fluorescence microscopy
- Wet Lab: cell culture; immunolabeling; sample preparation

Languages: Chinese (native), English (full professional proficiency), French (elementary proficiency)

Online Licenses & Certifications:

- *Deep Learning Specialization*, DeepLearning.AI
- *Introduction to Programming with MATLAB*, Vanderbilt University

Professional Activities

Spectra, Optica (formerly OSA) & SPIE joint student chapter at *Washington University in St. Louis*

Co-president (Optica liaison) — 2023 - 2024

Vice president (Imaging Science Pathway liaison) — 2022 - 2023

Medical Physics Summer School at *Duke Kunshan University* — Aug 2020

The Physics of Life Summer School (virtural) at the *Center for the Physics of Biological Function, Princeton University* June 2020 - Aug 2020

Optica (formerly OSA) **student chapter** at *School of Physics, Nankai University*
Student officer 2018 - 2020

Teaching Experiences

Fundamentals and Applications of Modern Optical Imaging Spring 2024
Washington University in St. Louis
Assistant Instructor; Course Instructor: Dr. Matthew Lew

College Physics Fall 2019
Nankai University
Undergraduate Teaching Assistant; Course Instructor: Dr. Jianghong Yao