Tingting Wu

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Education

Ph.D. Candidate in Department of Electrical and System Engineering Sep 2018 - Dec 2023 (expected)
Imaging Science Program Mentor: Prof. Matthew D. Lew
Washington University in St. Louis (WashU)

Courses: *Optimization, Computer Vision, Machine Learning, Modern Optical Imaging, Theoretical Imaging Science, Computational Methods for Imaging Sciences, Mathematics of Imaging Science, Biological Imaging Technology, ...*

B.S. in Department of Electrical and Electronic Engineering 2014-2018
Optoelectronics Science and Engineering Program Graduate with Honor
Southern University of Science and Technology (SUSTech)

Courses: *Signal Processing and Systems, Probability and Statistics, Linear Algebra, Calculus, Geometric and Wave Optics, Optical Design with Zemax, Java, Electrical Circuits, Analog Circuit, Digital Circuit, General Physics ...*

Research Experience

Graduate research at Lew Lab, WashU Sep 2018 - Present
Single Molecules Orientation Localization Microscopy

- **Point spread function engineering using optimization algorithm.** design a microscope to encode the information of 3D locations and 3D orientations of single molecules into the shape of images captured by the camera. Optica, 2022
- **Smart microscopy design using adaptive polarization modulation of light.** adapt the structure of the microscope (e.g. polarization and structure of excitation light, wavefront shaping of emission light) during the experiment to achieve optimal estimation precision for 3D orientation and 3D position of single molecule
- **Deep-Learning based imaging processing algorithm design.** design a Deep-Learning based estimator to simultaneously estimate the orientations and locations from overlapped and noisy images of single molecules Optics Express, 2022
- **Iterative optimization based imaging processing algorithm design.** design an imaging estimation algorithm using negative-loglikelihood and FISTA algorithm to simultaneously estimate the orientations and locations (6-dimensional estimation) from Poisson shot noisy corrupt images of single molecules Optica, 2022
- **High-information imaging of biomolecular condensates.** nanoscale sensing and imaging of the heterogenous structures inside the biomolecular condensate using single-molecule imaging and tracking BioRxiv, 2023
- **Evaluation metric design based on information theory.** design evaluation metric to efficiently quantify the precision of different microscopes for measuring the 3D orientation of single molecules Optica, 2020
  Advisor: Prof. Matthew D. Lew

Undergraduate research at SUSTech

- **Phase retrieval algorithm design for optical ptychography.** study the scanning coherent diffraction imaging (ptychography) at visible light wavelengths and reconstruct the image using iterative phase retrieval algorithm
  Advisor: Prof. Fucai Zhang Feb 2018 - June 2018
- **Optical fiber sensor design using interfence.** design refractive index fiber sensor and displacement fiber sensor based on the interference between lights in cladding mode and in core mode J. Phys. Commun, 2018
  Advisor: Prof. Xinhai Zhang & Dr. Linlin Xu May 2016 - Jan 2018

Skills

- **Optics** microscopy design, simulation using geometric and wave optics, polarization system design, camera characterization, laser alignment, etc.
- **Computation** imaging estimation algorithm design based on iterative optimization and neural network
- **Programming** Matlab, Python, Java, Tensorflow and Pytorch
- **Soft skills** communication cross-group and in-group collaboration, scientific presentation and leadership

Publications

(Citations 107, h-index 4, i10-index 2 via google scholar)
∗ equally contributed

Refereed Publications

[8] **T. Wu**, M.R. King, M. Farag, R. V. Pappue, and M. D. Lew. "Single fluorogen imaging reveals spatial inhomogeneities within biomolecular condensates". In: ***BioRxiv*** (2023). DOI: https://doi.org/10.1101/2023.01.26.525727.

[7] O. Zhang, Z. Guo, Y. He, **T. Wu**, M. D. Vahey, and M. D. Lew. "Six-Dimensional Single-Molecule Imaging with Isotropic Resolution using a Multi-View Reflector Microscope". In: ***Nature Photonics*** (2022). DOI: https://doi.org/10.1101/2023.01.26.525727.

[6] **T. Wu**, P. Lu*, Md A. Rahman*, X. Li*, and M. D. Lew. "Deep-SMOLM: deep learning resolves the 3D orientations and 2D positions of overlapping single molecules with optimal nanoscale resolution". In: ***Optics Express*** 30.20 (2022), p. 36761. DOI: 10.1364/oe.470146.

[5] **T. Wu**, J. Lu, and M. D. Lew. "Dipole-spread-function engineering for simultaneously measuring the 3D orientations and 3D positions of fluorescent molecules". In: ***Optica*** 9.5 (2022), p. 505. DOI: 10.1364/optica.451899.

[4] O. Zhang, W. Zhou, J. Lu, **T. Wu**, and M. D. Lew. "Resolving the three-dimensional rotational and translational dynamics of single molecules using radially and azimuthally polarized fluorescence". In: ***Nano Letters*** 22.3 (2022), pp. 1024–1031. DOI: 10.1021/acs.nanolett.1c03948.

[3] T. Ding*, **T. Wu***, H. Mazidi, O. Zhang, and M. D. Lew. "Single-molecule orientation localization microscopy for resolving structural heterogeneities within amyloid fibrils". In: ***Optica*** 7.6 (2020), pp. 602–607. DOI: 10.1364/optica.388157.

[2] **T. Wu**, L. Xu, and X. Zhang. "High sensitivity refractive index sensor based on the semicircular bent fiber". In: ***Journal of Physics Communications*** 2.6 (2018), p. 065009. DOI: 10.1088/2399-6528/aacbob.

[1] D. Feng, Z. Ge, D. Wu, Y. Chen, **T. Wu**, J. Li, and J. He. "Enhanced thermoelectric properties of SnSe polycrystals via texture control". In: ***Physical Chemistry Chemical Physics*** 18.46 (2016), pp. 31821–31827. DOI: 10.1039/C6CP06466C.

Conference Publications

[2] **T. Wu**, J. Lu, and M. D. Lew. "pixOL: pixel-wise point spread function engineering for measuring the 3D orientation and 3D location of dipole-like emitters". In: ***Microscopy and Microanalysis***. Vol. 27. S1. 2021, pp. 858–862. DOI: 10.1017/S1431927621003366.

[1] **T. Wu**, T. Ding, H. Mazidi, O. Zhang, and M. D. Lew. "A computationally-efficient bound for the variance of measuring the orientation of single molecules". In: ***Single Molecule Spectroscopy and Superresolution Imaging XIII***. Vol. 1124616. February. SPIE, 2020, p. 35. DOI: 10.1117/12.2543813.

Conference Presentations

Oral Presentations

[5] "Mapping inhomogeneous network structures within biomolecular condensate using single-molecule imaging and tracking of fluorogenic probes". In: *Biophysical Society* (2023), San Diego, Ca, US.

[4] "Deep-SMOLM: imaging the 3D orientations and 2D positions simultaneously of single molecules using deep learning". In: *Gordon Research Seminar* (2022), Portland, Maine, US.

[3] "pixOL: pixel-wise point spread function engineering for measuring the 3D orientation and 3D location of dipole-like emitters". In: *Focus on Microscopy* (2022), Online.

[2] "pixOL: pixel-wise point spread function engineering for measuring the 3D orientation and 3D location of dipole-like emitters". In: *Microscopy and Microanalysis (M&M) Meeting* (2021), Online.

[1] "High sensitivity refractive index sensor based on a semicircle bent fiber". In: *2017 10th International Conference on Computer and Electrical Engineering (ICCEE 2017)* (2017), University of Alberta, Edmonton, Canada.

Poster Presentations

[3] "Deep-SMOLM: imaging the 3D orientations and 2D positions simultaneously of single molecules using deep learning". In: *Gordon Research Conference* (2022), Portland, Maine.

[2] "pixOL: pixel-wise point spread function engineering for measuring the 3D orientation and 3D location of dipole-like emitters". In: *Biophysical Society* (2022), San Francisco, US.

[1] "A computationally efficient bound for the variance of measuring the orientation of single molecules". In: *SPIE Photonic West* (2022), San Francisco, US.

Honor & Awards

Travel award for Biophysical Society Conference	Biophysical Society	2023
Second-place Poster Award	Imaging Sciences Pathway Retreat, WashU	2022
Student Scholar Award	Microscopy and Microanalysis (M&M) meeting	2021
Outstanding Graduate Student Assistant to the Instructor (AI) Award	ESE at WashU	2021
Travel Awards	St. Louis Chapter of Graduate Women in Science	2020
Graduation with Honor	SUSTech	2018
Scientific Research and Innovation Award	SUSTech	2017
First Place Merit-based Scholarship	SUSTech	2017,2018
Outstanding Freshmen Scholarship	SUSTech	2014
Interdisciplinary Contest In Modeling	Honorable Mention	2017
Tuition Scholarship	SUSTech	2014-2018

Other Professional Activities

- **Co-chair** for "Platform: Condensates: Physical Properties and Modeling II" at Biophysics Society Conference 67th annual meeting 2023

- **Initiator and Committee co-chair** of imaging science student seminar in WashU 2019-2021
  I organized ~20 seminars. I also build our 'imaging science library' for sharing the recorded presentations.
- **Invited research presenter** for incoming PhD students in math camp, WashU 2022
- **Committee member** for imaging science pathway retreat, WashU 2021
- **Mentor** for assistants instruction (AIs) in ESE 2021 fall, 2022 fall
- **Volunteer** of portal to the public, Saint Louis Science Center 2020
- **Assistant Instructor** of ESE 105, Intro to Electrical and Systems Engineering, WashU 2019 fall, 2020 fall
- **Publicity Minister** of Optical Society of America (OSA) in SUSTech 2017-2018
- Member of SPIE 2019-now
- Member of OSA 2017-now
- **Peer Tutor** of physics for international students in SUSTech 2017-2018