

Yide Zhang

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TRAINING AND EDUCATION

California Institute of Technology, Pasadena, California USA

Postdoctoral Scholar, Medical Engineering

2019 - Present

University of Notre Dame, Notre Dame, Indiana USA

Doctor of Philosophy, Electrical Engineering

2014 - 2019

Master of Science, Electrical Engineering

2014 - 2017

Dissertation: *Super-Sensitivity and Super-Resolution Quantitative Multiphoton Microscopy*

Huazhong University of Science and Technology, Wuhan, China

Bachelor of Engineering, Automation *with Highest Honors*

2010 - 2014

Thesis: *Research on Memristor-Based Memory Networks and Computing Technology*

RESEARCH EXPERIENCE

Caltech Optical Imaging Laboratory

2019 - Present

Postdoctoral Scholar

Advisor: Lihong V. Wang, Ph.D.

Pasadena, California USA

- Development of novel phase-contrast compressed ultrafast photography (CUP), a technique that images light-speed phase change signals in a single shot with up to 350 frames captured at up to 1 trillion frames per second.
- Development of universally-calibrated photoacoustic topography through an ergodic relay (PATER), a method that uses a single-element ultrasonic transducer to capture a wide-field photoacoustic image with a single laser shot at a 1 kHz frame rate.

Biophotonics Research Group

2014 - 2019

Research Assistant

Advisor: Scott S. Howard, Ph.D.

Notre Dame, Indiana USA

- Developed a theoretical framework for optimizing the SNR of multiphoton frequency-domain fluorescence lifetime imaging microscopy (FD-FLIM) and verified the results with Monte Carlo simulations.
- Experimentally demonstrated a super-sensitivity FD-FLIM technique with a two-fold improvement in imaging speed compared to the theoretical limit of conventional FD-FLIM.
- Theoretically analyzed the lifetime measurement error in FD-FLIM under fluorophore saturation conditions and experimentally demonstrated a method for eliminating this error.
- Invented stepwise optical saturation (SOS), a super-resolution fluorescence microscopy technique that could be easily implemented and required neither additional hardware nor complex post-processing.
- Generalized the concept of SOS and experimentally demonstrated the first implementation of super-resolution imaging in FD-FLIM.
- Combined deconvolution with SOS (DeSOS) to image cells in their native physiological environment and provided an open-access application for the generation of DeSOS images.
- Constructed the Fluorescence Microscopy Denoising (FMD) dataset that consisted of 12,000 real fluorescence microscopy images; it was the first microscopy image dataset dedicated for Poisson-Gaussian denoising and had been used to benchmark conventional and deep learning based denoising methods.
- Developed a novel and unbiased approach to segment FLIM images automatically by K-means clustering of FLIM phasors and demonstrated successful image segmentation on 2D and 3D FLIM images of fixed cells and living animals acquired with two different FLIM systems.
- Demonstrated that super-resolution radial fluctuations (SRRF), a super-resolution fluorescence microscopy technique, can be used to enhance the resolution of transmission electron microscopy images.

- Invented instant FLIM, a method that allows real-time acquisition and display of two-photon intensity, lifetime, and phasor imaging data; it was used to generate the first in vivo four-dimensional (4D) FLIM movies of mouse and zebrafish glial cell response to injury over 12 hours through intact skulls.
- Took charge of the design, budget, construction, and demonstration of all the experimental setups mentioned above; built the hardware and wrote the software from scratch.
- A news article about my Ph.D. research: <https://ee.nd.edu/thewire/articles/your-motivation-matters-engineering-to-heal>

National Key Laboratory of Image Processing & Intelligence

2012 - 2014

Research Assistant

Advisor: Zhigang Zeng, Ph.D.

Wuhan, China

- Simulated neural activities including learning, associative memory and forgetting in a memristive neural network with integrate-and-fire CMOS neurons and spike-rate-dependent plasticity synapses.
- Implemented exponential adaptive lag synchronization of two memristive neural networks using fuzzy methods.

PREPRINTS

- R1 **Yide Zhang**, Ian H. Guldner, Evan L. Nichols, David Benirschke, Cody J. Smith, Siyuan Zhang, and Scott S. Howard, “Instant FLIM enables 4D in vivo lifetime imaging of intact brains”, *bioRxiv*, Feb. 2020, DOI: 10.1101/2020.02.05.936039.

JOURNAL PUBLICATIONS

- J12 **Yide Zhang**, Sergei Rouvimov, Xiaotong Yuan, Karla Gonzalez-Serrano, Alan C. Seabaugh, and Scott S. Howard, “Resolution enhancement of transmission electron microscopy by super-resolution radial fluctuations”, *Applied Physics Letters*, vol. 116, no. 4, pp. 044105, Jan. 2020, DOI: 10.1063/1.5128353.
- J11 **Yide Zhang**, Takashi Hato, Pierre C. Dagher, Evan L. Nichols, Cody J. Smith, Kenneth W. Dunn, and Scott S. Howard, “Automatic segmentation of intravital fluorescence microscopy images by K-means clustering of FLIM phasors”, *Optics Letters*, vol. 44, no. 16, pp. 3928-3931, Aug. 2019, DOI: 10.1364/OL.44.003928.
- J10 **Yide Zhang**, Evan L. Nichols, Abigail M. Zellmer, Ian H. Guldner, Cody Kankel, Siyuan Zhang, Scott S. Howard, and Cody J. Smith, “Generating intravital super-resolution movies with conventional microscopy reveals actin dynamics that construct pioneer axons”, *Development*, vol. 146, no. 5, pp. dev171512, Mar. 2019, DOI: 10.1242/dev.171512. Supplementary software available at DOI: 10.7274/r0-5hhg-5578. [Featured News 1](#) [Featured News 2](#)
- J9 **Yide Zhang**, David Benirschke, Ola Abdalsalam, and Scott S. Howard, “Generalized stepwise optical saturation enables super-resolution fluorescence lifetime imaging microscopy”, *Biomedical Optics Express*, vol. 9, no. 9, pp. 4077-4093, Sept. 2018, DOI: 10.1364/BOE.9.004077.
- J8 **Yide Zhang**, Prakash D. Nallathamby, Genevieve D. Vigil, Aamir A. Khan, Devon E. Mason, Joel D. Boerckel, Ryan K. Roeder, and Scott S. Howard, “Super-resolution fluorescence microscopy by stepwise optical saturation”, *Biomedical Optics Express*, vol. 9, no. 4, pp. 1613-1629, Apr. 2018, DOI: 10.1364/BOE.9.001613. **NDIIF Award for Best Biological Imaging Publication 2018.** [Featured News](#)
- J7 Genevieve Vigil, **Yide Zhang**, Aamir Khan, and Scott Howard, “Description of deep saturated excitation multiphoton microscopy for super-resolution imaging”, *Journal of the Optical Society of America A*, vol. 34, no. 7, pp. 1217-1223, July 2017, DOI: 10.1364/JOSAA.34.001217.

- J6 Aamir A. Khan, Genevieve D. Vigil, **Yide Zhang**, Susan K. Fullerton-Shirey, and Scott S. Howard, “Silica-coated ruthenium-complex nanoprobe for two-photon oxygen microscopy in biological media”, *Optical Materials Express*, vol. 7, no. 3, pp. 1066-1076, Mar. 2017, DOI: 10.1364/OME.7.001066.
- J5 **Yide Zhang**, Genevieve D. Vigil, Lina Cao, Aamir A. Khan, David Benirschke, Tahsin Ahmed, Patrick Fay, and Scott S. Howard, “Saturation-compensated measurements for fluorescence lifetime imaging microscopy”, *Optics Letters*, vol. 42, no. 1, pp. 155-158, Jan. 2017, DOI: 10.1364/OL.42.000155.
- J4 **Yide Zhang**, Aamir A. Khan, Genevieve D. Vigil, and Scott S. Howard, “Super-sensitivity multiphoton frequency-domain fluorescence lifetime imaging microscopy”, *Optics Express*, vol. 24, no. 18, pp. 20862-20867, Sept. 2016, DOI: 10.1364/OE.24.020862.
- J3 **Yide Zhang**, Aamir A. Khan, Genevieve D. Vigil, and Scott S. Howard, “Investigation of signal-to-noise ratio in frequency-domain multiphoton fluorescence lifetime imaging microscopy”, *Journal of the Optical Society of America A*, vol. 33, no. 7, pp. B1-B11, July 2016, DOI: 10.1364/JOSAA.33.0000B1.
- J2 Gang Bao, **Yide Zhang**, and Zhigang Zeng, “Memory analysis for memristors and memristive recurrent neural networks”, *IEEE/CAA Journal of Automatica Sinica*, vol. 7, no. 1, pp. 96-105, Jan. 2020, DOI: 10.1109/JAS.2019.1911828.
- J1 Shiping Wen, Zhigang Zeng, Tingwen Huang, and **Yide Zhang**, “Exponential adaptive lag synchronization of memristive neural networks via fuzzy method and applications in pseudo random number generators”, *IEEE Transactions on Fuzzy Systems*, vol. 22, no. 6, pp. 1704-1713, Dec. 2014, DOI: 10.1109/TFUZZ.2013.2294855.

CONFERENCE PUBLICATIONS

- C16 Varun Mannam, **Yide Zhang**, Yin hao Zhu, and Scott Howard, “Instant image denoising plugin for ImageJ using convolutional neural networks”, *Biomedical Optics 2020*, Washington, DC USA, Apr. 2020, DOI: 10.1364/TRANSLATIONAL.2020.JW2A.3.
- C15 **Yide Zhang**, Yin hao Zhu, Evan Nichols, Qingfei Wang, Siyuan Zhang, Cody Smith, and Scott Howard, “A Poisson-Gaussian denoising dataset with real fluorescence microscopy images”, *IEEE/CVF Conference on Computer Vision and Pattern Recognition (CVPR 2019)*, Long Beach, California USA, June 2019, DOI: 10.1109/CVPR.2019.01198.
- C14 **Yide Zhang**, Ian H. Guldner, Evan L. Nichols, David Benirschke, Cody J. Smith, Siyuan Zhang, and Scott S. Howard, “Three-dimensional deep tissue multiphoton frequency-domain fluorescence lifetime imaging microscopy via phase multiplexing and adaptive optics”, *SPIE Photonics West 2019*, San Francisco, California USA, Feb. 2019, DOI: 10.1117/12.2510674. **JenLab Young Investigator Award. Featured News**
- C13 **Yide Zhang**, David Benirschke, Ola Abdalsalam, and Scott S. Howard, “Super-resolution multiphoton frequency-domain fluorescence lifetime imaging microscopy by generalized stepwise optical saturation (GSOS)”, *SPIE Photonics West 2019*, San Francisco, California USA, Feb. 2019, DOI: 10.1117/12.2507663.
- C12 Ola Abdalsalam, **Yide Zhang**, Scott Howard, and Thomas D. O’Sullivan, “Self-calibrated frequency domain diffuse optical spectroscopy with a phased source array”, *SPIE Photonics West 2019*, San Francisco, California USA, Feb. 2019, DOI: 10.1117/12.2510422.
- C11 **Yide Zhang**, Prakash D. Nallathamby, Evan L. Nichols, Cody J. Smith, Ryan K. Roeder, and Scott S. Howard, “Super-resolution and high-speed quantitative multiphoton microscopy”, *Seventh Annual Harper Cancer Research Institute Research Day*, Notre Dame, Indiana USA, Apr. 2018, DOI: 10.7274/r0-zqes-kr15. **Poster Contest Third Prize.**

- C10 **Yide Zhang**, David Benirschke, and Scott S. Howard, “Stepwise optical saturation microscopy: obtaining super-resolution images with conventional fluorescence microscopes”, *Biomedical Optics 2018*, Hollywood, Florida USA, Apr. 2018, DOI: 10.1364/TRANSLATIONAL.2018.JTh3A.27.
- C9 **Yide Zhang**, David Benirschke, and Scott S. Howard, “Super-resolution fluorescence imaging by stepwise optical saturation microscopy”, *IEEE Annual Mini-symposium on Electron Devices and Photonics*, Notre Dame, Indiana USA, Oct. 2017, DOI: 10.7274/r0-bbyt-9j45. **Best Presentation Award.**
- C8 **Yide Zhang**, Genevieve D. Vigil, Aamir A. Khan, and Scott S. Howard, “Doubling the sensitivity of multiphoton frequency-domain fluorescence lifetime images”, *CLEO: Science and Innovations 2017*, San Jose, California USA, May 2017, DOI: 10.1364/CLEO_SI.2017.SM3C.6.
- C7 Genevieve D. Vigil, **Yide Zhang**, Aamir A. Khan, and Scott S. Howard, “Simulation and experimental design of saturated excitation (SAX) multiphoton microscopy (MPM)”, *CLEO: Applications and Technology 2017*, San Jose, California USA, May 2017, DOI: 10.1364/CLEO_AT.2017.JTu5A.64.
- C6 **Yide Zhang**, Genevieve D. Vigil, Aamir A. Khan, and Scott S. Howard, “Super-sensitivity and super-resolution multiphoton fluorescence lifetime imaging microscopy”, *NDnano Symposium: Nanotechnology in the Treatment of Neurodegenerative Disorders*, Notre Dame, Indiana USA, Mar. 2017, DOI: 10.7274/r0-k1dc-5q52. **Best Poster Award.**
- C5 Aamir A. Khan, Susan K. Fullerton-Shirey, Genevieve D. Vigil, **Yide Zhang**, and Scott S. Howard, “Highly stable two-photon oxygen imaging probe based on a ruthenium-complex encapsulated in a silica-coated nanomicelle”, *CLEO: Applications and Technology 2016*, San Jose, California USA, June 2016, DOI: 10.1364/CLEO_AT.2016.ATu4O.3.
- C4 Aamir A. Khan, Genevieve D. Vigil, **Yide Zhang**, and Scott S. Howard, “Theoretical analysis of the signal-to-noise ratio of two-photon oxygen imaging probes”, *Biomedical Optics 2016*, Fort Lauderdale, Florida USA, Apr. 2016, DOI: 10.1364/CANCER.2016.JW3A.48.
- C3 **Yide Zhang**, Genevieve D. Vigil, Aamir A. Khan, and Scott S. Howard, “High-resolution frequency-domain multiphoton fluorescence lifetime imaging microscopy”, *Fifth Annual Harper Cancer Research Institute Research Day*, Notre Dame, Indiana USA, Apr. 2016, DOI: 10.7274/r0-vt1g-bp12.
- C2 **Yide Zhang**, and Scott S. Howard, “On increasing the imaging rate of frequency-domain multiphoton fluorescence lifetime imaging microscopy”, *IEEE Annual Mini-symposium on Electronic and Photonics*, Notre Dame, Indiana USA, Oct. 2015, DOI: 10.7274/r0-dw42-x854.
- C1 **Yide Zhang**, Zhigang Zeng, and Shiping Wen, “Implementation of memristive neural networks with spike-rate-dependent plasticity synapse”, *IEEE International Joint Conference on Neural Networks (IJCNN)*, Beijing, China, July 2014, DOI: 10.1109/IJCNN.2014.6889740.

PATENTS

- P4 Scott Howard, **Yide Zhang**, and Cody J. Smith, “Super-resolution fluorescence microscopy by generalized stepwise optical saturation”, International Application Number: PCT/US2018/067905, Publication Number: WO2019133837A1.
- P3 Scott Howard, Genevieve Vigil, and **Yide Zhang**, “Super-sensitivity multiphoton frequency-domain fluorescence lifetime imaging microscopy”, International Application Number: PCT/US2017/021819, Publication Number: WO2017156413A1.
- P2 **Yide Zhang**, Zhigang Zeng, Shiping Wen, Mingfu Cao, Junfeng Zhao, “Neuron simulation circuit”, CN Application Number: CN201510508806.6A, Publication Number: CN106470023A.
- P1 **Yide Zhang**, Zhigang Zeng, Yidong Zhu, Mingfu Cao, Junfeng Zhao, “Signal processing circuit”, International Application Number: PCT/CN2015/080610, Patent Numbers: US10586590B2 (granted Mar. 10, 2020), EP3282449B1 (granted Aug. 7, 2019), CN107210064B (granted Feb. 14, 2020).

TEACHING EXPERIENCE

Kaneb Center for Teaching and Learning, University of Notre Dame 2018

- Certified participant of the Teaching Well Using Technology program that teaches faculty and graduate students how to use multi-media technology tools such as presentations, audios, videos, and digital timelines in an educational setting to enhance teaching and learning.

Biophotonics Research Group, University of Notre Dame 2017-2019

- Trained undergraduate and first-year graduate students how to perform confocal, two-photon, and fluorescence lifetime imaging experiments using commercial and custom-built microscopes.

Clay Intermediate Center, Clay International Academy 2016

- Participated in an outreach program to go to middle school classrooms and demonstrate cool optics demos and principles to students and inspire them to pursue a career in science.

Department of Electrical Engineering, University of Notre Dame 2015

- As a teaching assistant of EE 30342 - Microelectronic Circuit Design, graded homework, ran weekly Q&A sessions, and assisted undergraduate students in performing microelectronic experiments.

School of Automation, Huazhong University of Science and Technology 2014

- Mentored six undergraduate students to complete their undergraduate thesis projects.

SELECTED AWARDS AND HONORS

2020	IOP Publishing Outstanding Reviewer Award , IOP Publishing, Bristol UK
2019	NDIIF Best Biological Imaging Publication Award 2018 , Featured News Notre Dame Integrated Imaging Facility (NDIIF), Indiana USA
2019	CRC Award for Computational Sciences and Visualization , Featured News Center for Research Computing (CRC), University of Notre Dame, Indiana USA
2019	JenLab Young Investigator Award , Featured News Multiphoton Microscopy in the Biomedical Sciences XIX, SPIE Photonics West
2018	James L. Massey Travel Grant , Department of Electrical Engineering, University of Notre Dame, Indiana USA
2018	Poster Contest Third Prize , Seventh Annual Harper Cancer Research Institute Research Day, Indiana USA
2017	Best Presentation Award , IEEE Annual Mini-symposium on Electron Devices and Photonics, Indiana USA
2017	Berry Family Foundation Graduate Fellowship , Featured News Advanced Diagnostics and Therapeutics (AD&T), Indiana USA
2017	2016 Graduate Student Research Award (One Awardee at NDEE), Department of Electrical Engineering, University of Notre Dame, Indiana USA
2017	Best Poster Award , NDnano Symposium, University of Notre Dame, Indiana USA
2014	Outstanding Undergraduate Thesis Award (Ranking 1/205), Huazhong University of Science and Technology (HUST), Wuhan, China
2013	Meritorious Winner , Mathematical Contest in Modeling (MCM), Consortium for Mathematics and Its Applications (COMAP)
2013	Decent Capital's Scholarship (Top 0.1%), Decent Capital
2011-2013	National Scholarship ×3 (Top 1%), Ministry of Education of China
2012	Prominent Student Award (Top 1%), HUST, Wuhan, China

RESEARCH INTERESTS

Photoacoustic microscopy (PAM), photoacoustic computed tomography (PACT), compressed ultrafast photography (CUP), nonlinear microscopy, multiphoton microscopy (MPM), fluorescence lifetime imaging microscopy (FLIM), super-resolution microscopy, high-speed imaging, deep tissue imaging, adaptive optics, computational imaging, deep learning.

PROFESSIONAL SERVICE

Invited Speaker

- “NDCSSA Excellent Graduate Experience Sharing Session”, Notre Dame Chinese Students and Scholars Association (NDCSSA) Talk No. 3, Aug. 28, 2019.
- “NDIIF Best Biological Imaging Publication Award 2018: Stepwise Optical Saturation (SOS) Microscopy and Beyond”, 6th Annual Midwest Imaging and Microanalysis Workshop, May 6, 2019.
- “Three-Dimensional, Deep Tissue, Super-Resolution Multiphoton FLIM via Phase Multiplexing”, AD&T External Review, Mar. 25, 2019.
- “Research in ND Electrical Engineering: A Graduate Student’s Perspective”, Notre Dame Electrical Engineering Graduate Applicant Recruiting Event, Mar. 8, 2019.
- “Novel Super-Resolution Fluorescence Microscopy Methods in Application to Bio and Materials Sciences”, Notre Dame Electron Microscopy Club Meeting, Feb. 13, 2019.

Journal Reviewer

- Nature Biomedical Engineering
- Biomedical Optics Express
- Optics Letters
- Optics Express
- Optical Engineering
- Optics Communications
- Applied Physics Letters
- Applied Optics
- Photonics Research
- Journal of Biophotonics
- Journal of Biomedical Optics
- Journal of the Optical Society of America A
- Journal of Electronic Imaging
- Review of Scientific Instruments
- Methods and Applications in Fluorescence
- Scientific Reports
- IEEE Transactions on Biomedical Engineering

Contributor to Research Community

- Certified Publons Academy Peer Reviewer, Publons, June 8, 2020.
- Certified Reviewer for OSA Journals, The Optical Society (OSA), Dec. 15, 2019.
- “ ‘Publish or perish’ will not perish”, Behavioural and Social Sciences at Nature Research, Oct. 10, 2019.
- “Bringing super-resolution microscopy to the masses”, Microscopy & Analysis, Sept. 11, 2019.

PROFESSIONAL MEMBERSHIP

Student Member, The Optical Society (OSA)

Student Member, International Society for Optics and Photonics (SPIE)

Student Member, Institute of Electrical and Electronics Engineers (IEEE)

PROFESSIONAL REFERENCES

Scott S. Howard, Ph.D.

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Department of Electrical Engineering
University of Notre Dame
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