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 nanoprobes 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.

SELECTED CONFERENCE PUBLICATIONS

C16   Varun Mannam, **Yide Zhang**, Yinhao 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**, Yinhao 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***. <u>Featured News</u>

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, pp. 2226-2233, 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**, <u>Featured News</u> Notre Dame Integrated Imaging Facility (NDIIF), Indiana USA
2019	**CRC Award for Computational Sciences and Visualization**, <u>Featured News</u> Center for Research Computing (CRC), University of Notre Dame, Indiana USA
2019	**JenLab Young Investigator Award**, <u>Featured News</u> 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**, <u>Featured News</u> 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

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