MATTHEW DUK-YING LEW

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APPOINTMENTS

Assistant Professor, Preston M. Green Department of Electrical and Systems Engineering 2015 – present
Affiliate of the Department of Biomedical Engineering; the DBBS Biochemistry, Biophysics, and Structural Biology Program; and the Institute of Materials Science & Engineering
Member of the Center for Science and Engineering of Living Systems
Washington University in St. Louis

EDUCATION AND TRAINING

Postdoctoral Scholar 2014 – 2015
Department of Structural Biology, Stanford University School of Medicine
Molecular Imaging: Speckle-Modulating Optical Coherence Tomography
Research Advisor: Adam de la Zerda

Ph.D. in Electrical Engineering, 4.0 GPA 2015
Stanford University
Engineering New Capabilities into Optical Microscopes: Toward Measuring the Three-Dimensional Position and Orientation of Single Molecules in Living Cells
Research Advisor: W. E. Moerner

Research Intern 2014
Google[x], Mountain View, CA

M.S. in Electrical Engineering, 3.9 GPA 2010
Stanford University

B.S. with Honor in Electrical Engineering, 4.0 GPA 2008
California Institute of Technology
Quantitative Differential Phase Imaging and Phase Reconstruction
Research Advisor: Changhuei Yang

AWARDS AND RECOGNITIONS

Outstanding Teaching Award, *Washington University Department of Electrical and Systems Engineering*	2020
Full Membership Inductee, *Sigma Xi The Scientific Research Honor Society*	2020
National Science Foundation CAREER Award	2017-2022
Hiruma/Wagner Award, *16th Conference of Peace through Mind/Brain Science*	2016
Winner of 2015 After Image Photo Contest, *Optics & Photonics News*	2015
Second Place Poster Award, Gordon Research Conferences: Single-Molecule Approaches to Biology	2012
Stanford Bio-X Travel Award	2010, 2011
PicoQuant Young Investigator Award	2010
National Science Foundation Graduate Research Fellowship	2008

Newport-Spectra Physics Research Excellence Award	2008
Stanford Graduate Fellowship, 3Com Corporation Fellow	2008
Tau Beta Pi Fellow No. 762	2008
Graduation with Honor, California Institute of Technology	2008
Caltech Carnation Merit Award	2007
Caremark Rx Scholarship	2006, 2007
Tau Beta Pi Scholarship	2007
Caltech Summer Undergraduate Research Fellowship, Rita A. and Φistein Skjellum Fellow	2006
Caltech Perpall Speaking Competition Finalist	2006
College Board National Advanced Placement Scholar	2004
MasterCard Alamo Bowl Scholarship	2004
National Merit Scholarship	2004

PUBLICATIONS

h-index: 18, i10-index: 20, *equal contribution, [+]co-corresponding authors, †cover article

Refereed Publications

22. M. Shen, T. Ding, J. Luo, C. Tan, K. Mahmood, Z. Wang, D. Zhang, R. Mishra, **M. D. Lew**, and B. Sadtler, "Competing Activation and Deactivation Mechanisms in Photodoped Bismuth Oxybromide Nanoplates Probed by Single-Molecule Fluorescence Imaging," *J. Phys. Chem. Lett.* **11**, 5219 (2020).
21. T. Ding, T. Wu, H. Mazidi, O. Zhang, and **M. D. Lew**, "Single-molecule orientation localization microscopy for resolving structural heterogeneities between amyloid fibrils," *Optica* **7**, 602 (2020).
20. M. Shen, T. Ding, S. T. Hartman, F. Wang, C. Krucylak, Z. Wang, C. Tan, B. Yin, R. Mishra, **M. D. Lew**, and B. Sadtler, "Nanoscale Colocalization of Fluorogenic Probes Reveals Role of Oxygen Vacancies in the Photocatalytic Activity of Tungsten Oxide Nanowires," *ACS Catal.* **10**, 2088 (2020).
19. H. Mazidi, E. S. King, O. Zhang, A. Nehorai, and **M. D. Lew**, "Dense Super-Resolution Imaging of Molecular Orientation via Joint Sparse Basis Deconvolution and Spatial Pooling," *2019 IEEE 16th International Symposium on Biomedical Imaging (ISBI 2019)*, 325 (2019).
18. O. Zhang and **M. D. Lew**, "Fundamental Limits on Measuring the Rotational Constraint of Single Molecules using Fluorescence Microscopy," *Phys. Rev. Lett.* **122**, 198301 (2019).
17. H. Mazidi, J. Lu, A. Nehorai, and **M. D. Lew**, "Minimizing Structural Bias in Single-Molecule Super-Resolution Microscopy," *Sci. Rep.* **8**, 13133 (2018).
16.† D. Maji, J. Lu, P. Sarder, A. H. Schmieder, G. Cui, X. Yang, D. Pan, **M. D. Lew,** S. Achilefu, and G. M. Lanza, "Cellular Trafficking of Sn-2 Phosphatidylcholine Prodrugs Studied with Fluorescence Lifetime Imaging and Super-resolution Microscopy," *Prec. Nanomed.* **1**, 128 (2018).
15.† K. Spehar*, T. Ding*, Y. Sun, N. Kedia, J. Lu, G. R. Nehass, **M. D. Lew[+]**, and J. Bieschke[+], "Super-resolution imaging of amyloid structures over extended times using transient binding of single thioflavin T molecules," *ChemBioChem* **19**, 1944 (2018).
14. O. Zhang, J. Lu, T. Ding, and **M. D. Lew**, "Imaging the three-dimensional orientation and rotational mobility of fluorescent emitters using the Tri-spot point spread function," *Appl. Phys. Lett.* **113**, 031103 (2018). Correction: *Appl. Phys. Lett.* **115**, 069901 (2019).
13. O. Liba, **M. D. Lew,** E. D. SoRelle, R. Dutta, D. Sen, D. M. Moshfeghi, S. Chu, and A. de la Zerda, "Speckle-modulating optical coherence tomography in living mice and humans," *Nat. Commun.* **8**, 15845 (2017).
-- Featured in *Nat. Methods* **14**, 767 (2017): "Research Highlights: Methods in Brief."
12.† A. von Diezmann, M. Y. Lee, **M. D. Lew,** and W. E. Moerner, "Correcting field-dependent aberrations with nanoscale accuracy in three-dimensional single-molecule localization microscopy," *Optica* **2**, 985 (2015).

11. **M. D. Lew** and W. E. Moerner, "Azimuthal polarization filtering for accurate, precise, and robust single-molecule localization microscopy," *Nano Lett.* **14**, 6407 (2014).
10. A. S. Backer, M. P. Backlund, **M. D. Lew**, and W. E. Moerner, "Single-molecule orientation measurements with a quadrated pupil," *Opt. Lett.* **38**, 1521 (2013).
9.† **M. D. Lew***, M. P. Backlund*, and W. E. Moerner, "Rotational mobility of single molecules affects localization accuracy in super-resolution fluorescence microscopy," *Nano Lett.* **13**, 3967 (2013).
8. M. P. Backlund*, **M. D. Lew***, A. S. Backer, S. J. Sahl, G. Grover, A. Agrawal, R. Piestun, and W. E. Moerner, "Simultaneous, accurate measurement of the 3D position and orientation of single molecules," *Proc. Natl. Acad. Sci. USA* **109**, 19087 (2012).
   -- Featured in *Nat. Methods* **10**, 13 (2013): "Research Highlights: Methods in Brief."
7.† H-L. D. Lee*, S. J. Sahl*, **M. D. Lew**, and W. E. Moerner, "The double-helix microscope super-resolves extended biological structures by localizing single blinking molecules in three dimensions with nanoscale precision," *Appl. Phys. Lett.* **100**, 153701 (2012).
6. **M. D. Lew***, S. F. Lee*, J. L. Ptacin, M. K. Lee, R. J. Twieg, L. Shapiro, and W. E. Moerner, "Three-dimensional superresolution colocalization of intracellular protein superstructures and the cell surface in live *Caulobacter crescentus*," *Proc. Natl. Acad. Sci. USA* **108**, E1102 (2011).
5. **M. D. Lew**, S. F. Lee, M. Badieirostami, and W. E. Moerner, "Corkscrew point spread function for far-field three-dimensional nanoscale localization of pointlike objects," *Opt. Lett.* **36**, 202 (2011).
4. M. Badieirostami, **M. D. Lew**, M. A. Thompson, and W. E. Moerner, "Three-dimensional localization precision of the double-helix point spread function versus astigmatism and biplane," *Appl. Phys. Lett.* **97**, 161103 (2010).
3. M. A. Thompson*, **M. D. Lew***, M. Badieirostami, and W. E. Moerner, "Localizing and tracking single nanoscale emitters in three dimensions with high spatiotemporal resolution using a double-helix point spread function," *Nano Lett.* **10**, 211 (2010).
2. X. Cui, **M. Lew**, and C. Yang, "Quantitative differential interference contrast microscopy based on structured-aperture interference," *Appl. Phys. Lett.* **93**, 091113 (2008).
1. **M. Lew**, X. Cui, X. Heng, and C. Yang, "Interference of a four-hole aperture for on-chip quantitative two-dimensional differential phase imaging," *Opt. Lett.* **32**, 2963 (2007).

Review Articles and Book Chapters

3. **M. D. Lew**, S. F. Lee, M. A. Thompson, H-L. D. Lee, and W. E. Moerner, "Single-molecule photocontrol and nanoscopy," in Far-Field Optical Nanoscopy (eds. P. Tinnefeld, C. Eggeling, and S. W. Hell) **14**, 87 (Springer-Verlag, 2015).
2. M. P. Backlund, **M. D. Lew**, A. S. Backer, S. J. Sahl, and W. E. Moerner, "The role of molecular dipole orientation in single-molecule fluorescence microscopy and implications for super-resolution imaging," *ChemPhysChem* **15**, 587 (2014).
1. M. A. Thompson, **M. D. Lew**, and W. E. Moerner, "Extending microscopic resolution with single-molecule imaging and active control," *Annu. Rev. Biophys.* **41**, 321 (2012).

Other Publications

14. 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," *Proc. SPIE* **11246**, 1124616 (2019).
13. H. Mazidi, T. Ding, A. Nehorai, and **M. D. Lew**, "Measuring localization confidence for quantifying accuracy and heterogeneity in single-molecule super-resolution microscopy," *Proc. SPIE* **11246**, 1124611 (2020).
12. O. Zhang and **M. D. Lew**, "Fundamental limits of measuring single-molecule rotational mobility," *Proc. SPIE* **10884**, 1088412 (2019).
11. T. Ding, K. Spehar, J. Bieschke, and **M. D. Lew**, "Long-term, super-resolution imaging of amyloid structures using transient amyloid binding microscopy," *Proc. SPIE* **10884**, 108840J (2019).
10. O. Liba, **M. D. Lew,** E. D. SoRelle, R. Dutta, D. Sen, D. M. Moshfeghi, S. Chu, and A. de la Zerda, "Speckle-modulation for speckle reduction in optical coherence tomography," *Proc. SPIE* **10483**, 104832D (2018).
9. H. Mazidi, A. Nehorai, and **M. D. Lew**, "A robust statistical estimation (RoSE) algorithm jointly recovers the 3D location and intensity of single molecules accurately and precisely," *Proc. SPIE* **10500**, 105000E (2018).

8. O. Zhang, T. Ding, J. Lu, H. Mazidi, and **M. D. Lew**, "Measuring 3D molecular orientation and rotational mobility using a Tri-spot point spread function," *Proc. SPIE* **10500**, 105000B (2018).
7. A. S. Backer, M. P. Backlund, **M. D. Lew**, A. R. Diezmann, S. J. Sahl, and W. E. Moerner, "Single-molecule orientation measurements with a quadrated pupil," *Proc. SPIE* **8950**, 89500L (2014).
6. **M. D. Lew***, A. R. S. von Diezmann*, and W. E. Moerner, "Easy-DHPSF open-source software for three-dimensional localization of single molecules with precision beyond the optical diffraction limit," *Protocol Exchange* (2013). DOI: 10.1038/protex.2013.026
5. M. P. Backlund*, **M. D. Lew***, A. S. Backer, S. J. Sahl, G. Grover, A. Agrawal, R. Piestun, and W. E. Moerner, "The double-helix point spread function enables precise and accurate measurement of 3D single-molecule localization and orientation," *Proc. SPIE* **8590**, 85900L (2013).
4. **M. D. Lew**, M. A. Thompson, M. Badieirostami, and W. E. Moerner, "*In vivo* three-dimensional superresolution fluorescence tracking using a double-helix point spread function," *Proc. SPIE* **7571**, 75710Z (2010).
3. **M. Lew**, X. Cui, X. Heng, and C. Yang, "Two-dimensional differential interference contrast microscopy based on four-hole variation of Young's interference," *Proc. SPIE* **6859**, 685916 (2008).
2. X. Cui, **M. Lew**, X. Heng, and C. Yang, "On-chip differential interference contrast (DIC) phase imager and beam profiler based on Young's interference," *Proc. SPIE* **6441**, 64411F (2007).
1. **M. Lew**, X. Cui, and C. Yang, "Measuring the phase of light," *Caltech Undergraduate Research Journal* **6**, 18 (2007).

PATENTS

3. O. Zhang and **M. D. Lew**, inventors; Washington University, assignee. "Systems and methods for performing optical imaging using a tri-spot point spread function (PSF)," United States Patent Application 2018/0307132 A1 (2018).
2. O. Liba, **M. D. Lew**, E. D. SoRelle, and A. de la Zerda, inventors; The Board of Trustees of the Leland Stanford Junior University, assignee. "Methods and apparatus for speckle-free optical coherence imaging," United States Patent Application 2018/0299251 A1 (2018).
1. **M. D. Lew** and W. E. Moerner, inventors; The Board of Trustees of the Leland Stanford Junior University, assignee. "Apparatus and method for localizing objects for distance and/or in three dimensions using a spiral point spread function," United States Patent 9,693,034 B2 (2017).

ORAL PRESENTATIONS

Invited

23. "Quantifying and Maximizing Imaging Accuracy in Single-Molecule Super-Resolution Microscopy," *2020 IEEE 17th International Symposium on Biomedical Imaging (ISBI 2020)*, virtual conference, April 2020.
22. "Computational Modeling Enables Robust Multidimensional Nanoscopy," *25th Solvay Conference on Chemistry*, Brussels, Belgium, October 2019.
21. "Single Molecules and Point Spread Function Engineering for Visualizing Amyloid Protein Dynamics at the Nanoscale," *Imaging Sciences Pathway Retreat 2019*, St. Louis, MO, June 2019.
20. "Visualizing Amyloid Protein Dynamics at the Nanoscale," *5th Annual Meeting of the Biophysical Society of Canada*, Mississauga, ON, May 2019.
19. "Single-Molecule Orientation Spectroscopy," *Rice University Spectroscopic Imaging Workshop*, Houston, TX, December 2018.
18. "Towards Optimal Imaging of Single-Molecule Rotational Dynamics at the Nanoscale," *Gordon Research Conference: Single-Molecule Approaches to Biology*, West Dover, VT, July 2018.
17. "Computational Optics for Multidimensional Nanoscale Imaging of Single Fluorescent Molecules," *Stanford Optical Society Seminar*, Stanford, CA, June 2018.
16. "Elucidating the Functions of Molecular Machines in Living Cells," *Washington University School of Engineering & Applied Science National Council Meeting*, St. Louis, MO, April 2018.

15. "Single-Molecule Probes and Computational Optics for Imaging Activity at the Nanoscale," *Siteman Cancer Center Oncologic Imaging Research Forum*, St. Louis, MO, February 2018.
14. "Computational Optics for Imaging Nanoscale Single-Molecule Dynamics," *Washington University in St. Louis Chemistry Seminar*, St. Louis, MO, March 2017.
13. "Single molecules and computational optics for nanoscale biological imaging," *Washington University in St. Louis Optical Radiology Seminar*, St. Louis, MO, October 2016.
12. "Single molecules and computational optics for nanoscale biological imaging," *Washington University in St. Louis Biochemistry and Molecular Biophysics Seminar*, St. Louis, MO, March 2016.
11. "Single molecules and computational optics for nanoscale imaging of living cells," *The Sixteenth Conference of Peace through Mind Brain Science*, Hamamatsu City, Japan, February 2016.
10. "Single molecules and computational optics for nanoscale imaging of living cells," *Washington University in St. Louis Biomedical Engineering Seminar*, St. Louis, MO, February 2016.
9. "Accurate 3D nanoscale imaging of dipole-like emitters," *Laser Science 2015*, San Jose, CA, October 2015.
8. "Accurate nanoscale imaging of dipole-like emitters," *Stefan W. Hell group retreat*, Ringberg Castle, Kreuth, Germany, January 2015.
7. "Engineering new capabilities into optical microscopes: towards measuring the 3D position and orientation of biomolecules within living cells," *Washington University in St. Louis Electrical and Systems Engineering Seminar*, St. Louis, MO, April 2014.
6. "Beyond the clear pupil: engineering new capabilities into optical microscopes," *Washington University in St. Louis Electrical and Systems Engineering Seminar*, St. Louis, MO, March 2014.
5. "Beyond the clear pupil: engineering new capabilities into optical microscopes," *Duke University Electrical and Computer Engineering Seminar*, Durham, NC, March 2014.
4. "Beyond the clear pupil: engineering new capabilities into optical microscopes," *IBM Research Almaden ARC Angels Student Seminar Series*, San Jose, CA, February 2014.
3. "Superresolution far-field optical microscopy: turning mountains into points," *Spectra-Physics company seminar*, Santa Clara, CA, November 2011.
2. "Three-dimensional superresolution fluorescence microscopy using a double-helix point spread function," *Arizona State University Center for Biological Physics Graduate Seminar*, Tempe, AZ, November 2011.
1. "In vivo three-dimensional superresolution fluorescence tracking using a double-helix point spread function," S*PIE Photonics West BiOS (Biomedical Optics)*, San Francisco, CA, January 2010.

Contributed

18. "Quantifying Localization Accuracy in Single-Molecule Super-Resolution Microscopy," *Quantitative Bioimaging Conference 2020*, Oxford, UK, January 2020.
17. "Single-Molecule Super-Resolution Imaging of Molecular Orientation using a Tri-Spot Point Spread Function," *OSA Imaging and Applied Optics*, Munich, Germany, June 2019.
16. "Fundamental Limits on Imaging the Orientational Dynamics of Dipole-Like Emitters," *OSA Imaging and Applied Optics*, Munich, Germany, June 2019.
15. "Computational Optics for Multidimensional Nanoscale Imaging of Single Fluorescent Molecules," *Gordon Research Conferences: Image Science*, Easton, MA, June 2018 (poster).
14. "Computational Nanoscopy for Multidimensional Imaging of Single Fluorescent Molecules," *Gordon Research Conferences: Image Science*, Easton, MA, June 2016 (poster).
13. "An azimuthal polarizer assures localization accuracy in single-molecule super-resolution fluorescence microscopy," *OSA CLEO: 2015*, San Jose, CA, May 2015.
12. "Optical methods for measuring single-molecule orientation and position: implications for super-resolution microscopy," *OSA Frontiers in Optics (FiO)*, Orlando, FL, October 2013 (postdeadline).
11. "Measuring the 3D position and orientation of single molecules simultaneously and accurately with the double helix microscope," *OSA CLEO: 2013*, San Jose, CA, June 2013.
10. "The double-helix microscope simultaneously measures single-molecule orientation and 3D position, reducing dipole-induced localization errors," *Understanding Cell Behavior through Single Cell and Single Molecule Biology: Conference on Quantitative Bioimaging*, Albuquerque, NM, January 2013.

9. "The double-helix microscope simultaneously measures single-molecule orientation and 3D position, reducing dipole-induced localization errors," *Gordon Research Conferences: Single-Molecule Approaches to Biology*, West Dover, VT, July 2012 (2nd place poster award).
8. "Superresolution double-helix microscopy resolves extended biological superstructures in 3D within bacterial and mammalian cells," *Stanford Molecular Biophysics Seminar*, Stanford, CA, April 2012.
7. "Super-resolution 3D co-localization of protein superstructures and the cellular surface in live *Caulobacter crescentus*," *OSA FiO*, San Jose, CA, October 2011.
6. "Super-resolution 3D co-localization of protein superstructures and the cellular surface in live *Caulobacter crescentus*," *International OSA Network of Students-North America 3 (IONS-NA3)*, Stanford, CA, October 2011.
5. "Three-dimensional super-resolution imaging with a corkscrew point spread function," *OSA Novel Techniques in Microscopy*, Monterey, CA, April 2011.
4. "Three-dimensional super-resolution co-localization of intracellular protein superstructures and the cell membrane in live *Caulobacter crescentus*," *3rd Annual Center for Biological Imaging at Stanford Symposium*, Stanford, CA, March 2011.
3. "Three-dimensional superresolution imaging of single emitters using a double-helix point spread function," *Picoquant 16th Annual Workshop on Single Molecule Spectroscopy and Ultrasensitive Analysis in the Life Sciences*, Berlin, Germany, September 2010.
2. "Localization precision of three-dimensional superresolution fluorescence imaging using a double-helix point spread function," *OSA Computational Optical Sensing and Imaging*, San Jose, CA, October 2009.
1. "Two-dimensional differential interference contrast microscopy based on four-hole variation of Young's interference," *SPIE Photonics West BiOS*, San Jose, CA, January 2008.

TEACHING EXPERIENCE

Semester (Number enrolled)

ESE 105 (undergraduate), Developer and Co-Instructor Fall '18 (36), Fall '19 (67)
Introduction to Electrical and Systems Engineering

ESE 582 (graduate), Developer and Instructor Fall '15 (18), Spring '17 (15), '18 (28), '19 (12), '20 (18)
Fundamentals and Applications of Modern Optical Imaging

ESE 330 (undergraduate), Instructor Fall '16 (37)
Engineering Electromagnetics Principles

EE 134 (undergraduate), Developer and Guest Lecturer 2012
Introduction to Photonics (taught by Audrey K. Bowden)
Stanford University

EE 20 and EE 113 (undergraduate), Teaching Assistant 2006 – 2008
Electronics Laboratory (taught by Dimitrios Antsos), Feedback and Control Circuits (taught by Glen George)
California Institute of Technology

OTHER PROFESSIONAL ACTIVITIES

Conference Leadership

Program Committee, Stanford University Photonics Retreat (SUPR) 2015 2015
Asilomar Conference Grounds, Pacific Grove, CA

Program Committee, SUPR 2014 2014
Marconi Conference Center, Marshall, CA

Program Chair, SUPR 5 2013
DoubleTree Hotel Sonoma Wine Country, Rohnert Park, CA

Program Committee, SUPR 2012 2012
Asilomar Conference Grounds, Pacific Grove, CA

Program Committee, International OSA Network of Students (IONS) North America-3 2012
Stanford University

Peer Reviewer (Funding Agencies)
National Institutes of Health (Enabling Bioanalytical and Imaging Technologies (EBIT)), National Science Foundation (Division of Electrical, Communications and Cyber Systems), Department of Energy (Basic Energy Sciences)

Peer Reviewer (Journals): publons profile 1432593
Nature Methods, Nature Structural & Molecular Biology, Nature Communications, Chemical Science, Scientific Reports, Optics Letters, IEEE Access, Applied Physics Letters, Biophysical Journal, Biomedical Optics Express, Optics Express, Journal of the Optical Society of America A, IEEE Transactions on Computational Imaging

Service to Washington University in St. Louis
Advisor, MO Gamma Chapter, Tau Beta Pi 2020 – present
McKelvey School of Engineering

Laser Safety Advisory Committee 2018 – present

PhD Admissions Committee, Imaging Science PhD Program 2018 – present
McKelvey School of Engineering

Doctoral Admissions Committee, Department of Electrical and Systems Engineering 2017 – present

Curriculum Committee, Imaging Science PhD Program 2017 – present
McKelvey School of Engineering

Faculty Search Committee, Department of Electrical and Systems Engineering 2016, 2017, 2020

Department Chair Search Committee, Electrical and Systems Engineering, 2018
School of Engineering & Applied Science

Service to the Optical Society (OSA)

Chair, Molecular Probes and Nanobio-Optics Technical Group 2017 – 2019

Co-President, Stanford Optical Society, Student Chapter of OSA and SPIE 2013 – 2014
Stanford University
-- Recipient of The Optical Society's 2014 Student Chapter Excellence Award

Service to Tau Beta Pi
President, California Beta Chapter 2007 – 2008
California Institute of Technology

Service to IEEE
Vice Chair, Caltech Chapter 2007 – 2008
California Institute of Technology

Community Outreach

- Portal to the Public, Saint Louis Science Center 2016 – present
- LEGO Microscopes, Washington University SPECTRA 2016

Professional Society Memberships

IEEE Engineering in Medicine and Biology Society 2020 – present
Sigma Xi, The Scientific Research Honor Society 2020 – present
American Association for the Advancement of Science 2017 – present
American Chemical Society 2015 – present
The Optical Society (OSA) 2008 – present
SPIE 2007 – present
Tau Beta Pi 2007 – present