

MATTHEW DUK-YING LEW

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APPOINTMENTS

Assistant Professor, Preston M. Green Department of Electrical and Systems Engineering 2015 – present
Assistant Professor, by courtesy, Department of Biomedical Engineering
Affiliated Faculty, Biochemistry, Biophysics, and Structural Biology Program
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

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 Øistein 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: 17, i10-index: 17, *equal contribution, †co-corresponding authors, ‡cover article

Refereed Journal Publications

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**, 127 (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).
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

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. "Systems and Methods for Performing Optical Imaging using a Tri-Spot Point Spread Function (PSF)," United States Provisional Patent Application (2017).
2. **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 US 9,693,034 B2 (2017).

1. 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," International Patent Application PCT/US2016/057656 (2016).

ORAL PRESENTATIONS

Invited

16. "Towards Optimal Imaging of Single-Molecule Rotational Dynamics at the Nanoscale," *Gordon Research Conference: Single-Molecule Approaches to Biology*, West Dover, VT, July 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," *SPIE Photonics West BIOS (Biomedical Optics)*, San Francisco, CA, January 2010.

Contributed

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 Introduction to Electrical and Systems Engineering	Fall '18
ESE 582 (graduate), Developer and Instructor Fundamentals and Applications of Modern Optical Imaging	Fall '15 (18), Spring '17 (15), '18 (28)
ESE 330 (undergraduate), Instructor Engineering Electromagnetics Principles	Fall '16 (37)
EE 134 (undergraduate), Developer and Guest Lecturer Introduction to Photonics (taught by Audrey K. Bowden) Stanford University	2012
EE 20 and EE 113 (undergraduate), Teaching Assistant Electronics Laboratory (taught by Dimitrios Antsos), Feedback and Control Circuits (taught by Glen George) California Institute of Technology	2006 – 2008

OTHER PROFESSIONAL ACTIVITIES

Conference Leadership Program Committee, Stanford University Photonics Retreat (SUPR) 2015 Asilomar Conference Grounds, Pacific Grove, CA	2015
Program Committee, SUPR 2014 Marconi Conference Center, Marshall, CA	2014

Program Chair, SUPR 5 DoubleTree Hotel Sonoma Wine Country, Rohnert Park, CA	2013
Program Committee, SUPR 2012 Asilomar Conference Grounds, Pacific Grove, CA	2012
Program Committee, International OSA Network of Students (IONS) North America-3 Stanford University	2012
Peer Reviewer (Funding Agencies)	
National Science Foundation (Division of Electrical, Communications and Cyber Systems)	
Peer Reviewer (Journals): publons profile 1432593	
Biomedical Optics Express, Biophysical Journal, Journal of the Optical Society of America A, Optics Express, Optics Letters, Scientific Reports	
Service to Washington University in St. Louis	
Chair Search Committee, Department of Electrical and Systems Engineering	2018
PhD Admissions Committee, Department of Electrical and Systems Engineering	2017, 2018
Faculty Search Committee, Department of Electrical and Systems Engineering	2016, 2017
Planning Committee, Imaging Science PhD Program, School of Engineering & Applied Science	2017
JSEAS Panelist, Junior SEAS Faculty Group	2017
Service to the Optical Society (OSA)	
Chair, Molecular Probes and Nanobio-Optics Technical Group	2017 – present
Co-President, Stanford Optical Society, Student Chapter of OSA and SPIE Stanford University	2013 – 2014
-- Recipient of The Optical Society's 2014 Student Chapter Excellence Award	
Service to Tau Beta Pi	
President, California Beta Chapter California Institute of Technology	2007 – 2008
Service to IEEE	
Vice Chair, Caltech Chapter California Institute of Technology	2007 – 2008
Community Outreach	
<ul style="list-style-type: none"> • LEGO Microscopes, Washington University SPECTRA • Portal to the Public, Saint Louis Science Center 	
Professional Society Memberships	
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