

# Roarke Horstmeyer

## School Address

Charité Medical School  
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## EDUCATION

- Doctorate*, Electrical Engineering  
California Institute of Technology, Pasadena, CA October 2015  
THESIS - Computational microscopy: turning megapixels into gigapixels
- Master of Science*, MIT Media Lab  
Massachusetts Institute of Technology, Cambridge, MA August 2011  
THESIS - Towards a unified treatment of 3D display using partially coherent light
- Bachelor of Science*, Physics and Japanese (double major)  
Duke University, Durham, NC December 2006

## PROFESSIONAL EXPERIENCE

- Bioimaging and Neurophotronics Lab, Berlin, Germany* March 2016 – Current  
Einstein International Postdoctoral Fellow
- Working with Prof. Benjamin Judkewitz to apply digital optical phase conjugation in neuroscience
  - Co-appointed as fellow at Charité Medical School and Humboldt University of Berlin
- Nanotronics Imaging, Hollister, CA* November 2015 – March 2016  
Technical Consultant
- Developed a new computational microscope for semiconductor wafer inspection
- Beansprock.com, Cambridge, MA* January 2011 – January 2013  
Job recommendation engine start-up from the MIT Media Lab
- Co-founder and algorithm developer
  - Constructed recommendation pipeline to pair skills with careers, based upon natural language processing and large-scale statistical modeling
- The MITRE Corporation, Mclean, VA* November 2007 – August 2009  
Emerging Technologies Department
- Multi-discipline engineer, performed experimental research on unconventional optical techniques with Dr. Ravi Athale. Main topics included light fields, coded apertures, and computational imaging
  - Other research: chip-to-chip interconnects, silicon waveguides, compressive imaging, phase-space optics
- Stanford University, Stanford, CA* Summer 2005, 2006 & 2007  
Stanford Education Program for Gifted Youth
- Resident counselor and instructor for gifted high school students in cosmology, special relativity, general relativity, and particle physics courses

- Raman spectroscopy research with Dr. David Brady and Dr. Bob Guenther

### PEER-REVIEWED PAPERS

1. R. Horstmeyer, J. Chung, X. Ou, G. Zheng and C. Yang, “Diffraction tomography with Fourier ptychography,” *Optica* **8**, 827–835 (2016)
2. R. Horstmeyer, R. Heintzmann, G. Popescu, L. Waller and C. Yang, “Standardizing the resolution claims for coherent microscopy,” *Nature Photonics* **9**, 68–71 (2016).
3. X. Ou, J. Chung, R. Horstmeyer and C. Yang, “Aperture scanning Fourier ptychographic microscopy,” *Biomedical Optics Express* **7**, 3140–3150 (2016).
4. J. Chung, J. Kim, X. Ou, R. Horstmeyer and C. Yang, “Wide field-of-view fluorescence image deconvolution with aberration estimation from Fourier ptychography,” *Biomedical Optics Express* **7**, 352–368 (2016).
5. M. Henninger, J. Deguchi, Y. G. Yoon, R. Horstmeyer, R. Raskar and E. S. Boyden, “Implantable light field microimagers: a concept for in vivo physiological recording at large scale with single-cell resolution,” *Journal of Biomedical Optics*, under review (2016)
6. J. Holloway, M. S. Asif, M. K. Sharma, N. Matsuda, R. Horstmeyer, O. Cossairt and A. Veeraraghavan, “Toward long distance, sub-diffraction imaging using coherent camera arrays,” *IEEE Trans. Computational Imaging* (2016).
7. R. Horstmeyer, H. Ruan and C. Yang, “Guidestar-assisted wavefront-shaping methods for focusing light into biological tissue,” *Nature Photonics* **9**, 563–571 (2015)
8. B. Judkewitz\*, R. Horstmeyer\*, I. M. Vellekoop, I. N. Papadopoulos and C. Yang, “Translation correlations in anisotropically scattering media,” *Nature Physics* **11**, 684–689 (2015) (\*shared first authorship)
9. R. Horstmeyer, R. Y. Chen, X. Ou, B. Ames, J. A. Tropp and C. Yang, “Solving ptychography with a convex relaxation,” *New Journal of Physics* **15**, 053044 (2015)
10. R. Horstmeyer, S. Assaworarith, U. Ruhrmair and C. Yang, “Physically secure and fully reconfigurable data storage using optical scattering,” *IEEE Hardware Oriented Security and Trust*, 157–162 (2015)
11. X. Ou, R. Horstmeyer, G. Zheng and C. Yang, “High numerical aperture Fourier ptychography: principle, implementation and characterization,” *Optics Express* **23**, 3472–3491 (2015)
12. R. Horstmeyer, X. Ou, G. Zheng, P. Willems and C. Yang, “Digital pathology with Fourier ptychography,” *Computerized Medical Imaging and Graphics* **42**, 38–43 (2015)
13. R. Horstmeyer, X. Ou, J. Chung, G. Zheng and C. Yang, “Overlapped Fourier coding for optical aberration removal,” *Optics Express* **22**, 24062–24080 (2014)
14. S. Dong\*, R. Horstmeyer\*, R. Shiradkar, K. Guo, X. Ou, Z. Bian, H. Zin and G. Zheng, “Aperture-scanning Fourier ptychography for 3D refocusing and super-resolution macroscopic imaging,” *Optics Express* **22**, 13586–13599 (2014) (\*shared first authorship)
15. R. Horstmeyer and C. Yang, “A phase space model of Fourier ptychographic microscopy,” *Optics Express* **22**, 338–358 (2014)
16. J. L. Hollmann, R. Horstmeyer, C. Yang and C. A. DiMarzio, “Diffusion model for ultrasound-modulated light,” *Journal of Biomedical Optics* **19**, 035005 (2014)
17. G. Zheng, X. Ou, R. Horstmeyer, J. Chung and C. Yang, “Fourier ptychographic microscopy: creating a gigapixel microscope for biomedicine,” *Optics & Photonics News* **25**, 26–33 (2014, Cover paper)
18. X. Ou\*, R. Horstmeyer\*, C. Yang and G. Zheng, “Quantitative phase imaging via Fourier ptychographic microscopy,” *Optics Letters* **38**, 4845–4848 (2013) (\*shared first authorship)

19. G. Zheng, R. Horstmeyer and C. Yang, “Wide-field, high-resolution Fourier ptychographic microscopy,” *Nature Photonics* **7**, 739–745 (2013)
20. G. Zheng, X. Ou, R. Horstmeyer and C. Yang, “Characterization of spatially varying aberrations for wide field-of-view microscopy,” *Optics Express* **21**, 15131–15143 (2013)
21. B. Judkewitz, Y. M. Wang, R. Horstmeyer, A. Mathy and C. Yang, “Speckle-scale focusing in the diffusive regime with time-reversal of variance-encoded light (TROVE),” *Nature Photonics* **7**, 300–305 (2013)
22. R. Horstmeyer, B. Judkewitz, I. M. Vellekoop, S. Assaworarith and C. Yang, “Physical key-protected one-time pad,” *Scientific Reports* **3**, 3543 (2013)
23. J. L. Hollmann, R. Horstmeyer, C. Yang and C. A. DiMarzio, “Analysis and modeling of an ultrasound-modulated guide star to increase the depth of focusing in a turbid medium,” *Journal of Biomedical Optics* **18**(2), 025004 (2013).
24. R. Horstmeyer, R. Y. Chen, B. Judkewitz and C. Yang, “Markov speckle for efficient random bit generation,” *Optics Express* **20**, 26394–26410 (2012)
25. R. Horstmeyer, S. B. Oh, O. Gupta and R. Raskar, “Partially coherent ambiguity functions for depth-variant point spread function design,” *Progress in Electromagnetics Research Symposium (PIERS)* **7**(1), 95–100 (2011)
26. T. Cuypers, R. Horstmeyer, S. B. Oh, P. Bekaert and R. Raskar, “Validity of the Wigner distribution function for ray-based imaging,” *IEEE Int. Conf. Computational Photography (ICCP)*, 1-9 (2011)
27. J. Kim, R. Horstmeyer, I. J. Kim and R. Raskar, “Highlighted depth-of-field photography: Shining light on focus,” *ACM Transactions on Graphics (TOG)* **30**(3), 24 (2011).
28. R. Horstmeyer, S. B. Oh and R. Raskar, “Iterative aperture mask design in phase space using a rank constraint,” *Optics Express* **18**, 22545–22555 (2010)
29. R. Horstmeyer, R. A. Athale, and G. W. Euliss, “Modified light field architecture for reconfigurable multimode imaging,” *Proc. SPIE* 7468, 746804 (2009)
30. R. Horstmeyer, G. W. Euliss, R. A. Athale, and M. Levoy, “Flexible Multimodal Camera Using a Light Field Architecture,” *IEEE Int. Conf. Computational Photography (ICCP)*, 1–7 (2009)
31. R. Horstmeyer, G. W. Euliss, R. A. Athale, R. L. Morrison, R. A. Stack, and J. Ford, “Pupil plane multiplexing for multi-domain imaging sensors,” *Proc. SPIE* 7096, 709605 (2008)
32. R. H. Rubin, G. J. Ferland, E. E. Chollet, and R. Horstmeyer, “ $^{12}\text{C}/^{13}\text{C}$  Ratio in Planetary Nebulae from the IUE Archives,” *The Astrophysical Journal* **605**, 784–792 (2004)

### CONFERENCE PUBLICATIONS

- R. Horstmeyer, R. Y. Chen, X. Ou, B. Ames, J. A. Tropp and C. Yang, “Solving ptychography with a convex relaxation,” *SIAM Conference on Imaging Sciences* (Invited talk, 2016)
- J. Chung, J. Kim, X. Ou, R. Horstmeyer and C. Yang, “Simultaneous fluorescence and high-resolution bright-field imaging with aberrations correction over a wide field-of-view with FPM,” *SPIE BiOS* (2016).
- R. Horstmeyer, S. Assaworarith, U. Ruhmair and C. Yang, “Physically secure and fully reconfigurable data storage using optical scattering,” *IEEE HOST* (2015).
- R. Horstmeyer, G. Zheng, X. Ou and C. Yang, “Modeling extensions of Fourier ptychographic microscopy,” *Microscopy and Microanalysis* **20**, 370-371 (2014).
- R. Horstmeyer, X. Ou, G. Zheng, P. Willems and C. Yang, “Digital pathology with Fourier ptychography,” *European Congress on Digital Pathology* (2014).
- R. Horstmeyer, B. Judkewitz, I. M. Vellekoop and C. Yang, “Secure storage of cryptographic keys within random volumetric materials,” *Proc. OSA CLEO* (2013)

- R. Horstmeyer, S. Assaworarith and C. Yang, “Optical physical unclonable functions for reconfigurable public-key generation,” Workshop on Cryptographic Hardware and Embedded Systems (2013)
- B. Judkewitz, Y. M. Wang, R. Horstmeyer, A. Mathy and C. Yang, “Optical resolution imaging in the diffusive regime with time-reversal of variance-encoded light (TROVE),” Proc. OSA Novel Techniques in Microscopy (2013)
- R. Horstmeyer, S. B. Oh, H. Gao and R. Raskar, “Alternative models of the rotating beam,” Proc. OSA Conference on Digital Holography (2011)
- M. Henninger, R. Horstmeyer, A. Zorzos, J. Scholvin, D. Lanman, C. Fonstad, R. Raskar and E. S. Boyden, “A novel concept for an implantable probe for deep-brain optical measurement of the activity of large populations of neurons,” Society for Neuroscience (2011)
- R. Horstmeyer, S. B. Oh and R. Raskar, “Creating aperture masks in phase space,” Proc. OSA Imaging Systems (2010)
- R. L. Morrison, R. Stack, R. A. Athale, G. W. Euliss, B. F. Necioglu, R. Horstmeyer and C. Reese, “Dual-band imaging system based on a compact coaxial folded optic architecture,” Proc. OSA COSI (2009)
- R. Horstmeyer, B. Guenther, H. J. Kim and S. McCain, “Detection of Bilirubin using Raman Spectroscopy in a Neonatal Skull,” APS Division of Laser Science XXIII (2007)

#### BOOK CHAPTERS

- R. Horstmeyer, H. Ruan, M. Hoffmann and C. Yang, “Wavefront engineering for deep imaging,” to appear in *Neurophotonics*, edited by F. S. Pavone and S. Shoham (2017)
- R. Horstmeyer, I. M. Vellekoop and B. Judkewitz, “Transmission matrix correlations,” to appear in *Wavefront Shaping*, edited by J. Cubby (2017)

#### PATENTS

- R. Horstmeyer and C. Yang. Fourier ptychographic tomography. US Patent Application US 15/003559 (2016)
- R. Horstmeyer and C. Yang. Epi-Illumination Fourier Ptychographic Microscopy for Thick Biological Samples. US Patent Application US 14/979154 (2016)
- R. Horstmeyer and C. Yang. Multiplexed Fourier Ptychography Imaging Systems and Methods. US Patent Application US 14/960252 (2016)
- R. Horstmeyer, R. Y. Chen, J. A. Tropp and C. Yang. Ptychographic Imaging Systems and Methods with Convex Relaxation. US Patent Application US 14/710947 (2015)
- R. Horstmeyer, G. Zheng, X. Ou and C. Yang. Aperture Scanning Fourier Ptychographic Imaging. US Patent Application US 14/448,850 (2015)
- X. Ou, J. Chung, R. Horstmeyer, G. Zheng and C. Yang. Embedded Pupil Function Recovery for Fourier Ptychographic Imaging Devices. US Patent Application US 14/572493 (2015)
- R. Horstmeyer, X. Ou, G. Zheng and C. Yang. Variable Illumination Fourier Ptychographic Imaging Systems, Devices, and Methods. US Patent Application US 14/466,481 (2015)
- G. Zheng, C. Yang and R. Horstmeyer. Fourier Ptychographic Imaging Systems, Devices, and Methods. US Patent Application US 14/065,280 (2014)
- G. Zheng, C. Yang and R. Horstmeyer. Fourier Ptychographic X-ray Imaging Systems, Devices, and Methods. US Patent Application US 14/065,305 (2014)

- B. Judkewitz, Y. M. Wang, R. Horstmeyer and C. Yang. Time-reversal of variance-encoded light (TROVE). US Patent 9,354,116 (2014)
- R. Horstmeyer, B. Judkewitz, C. Yang and I. M. Vellekoop. Physical key-protected one-time pad. US Patent 9,054,871 (2015)

### REVIEWS AND ARTICLES

- R. Horstmeyer, “Effects of surface materials on polarimetric-thermal measurements: Applications to face recognition,” OSA Spotlight on Optics (2016).
- R. Horstmeyer, “Beyond the diffraction limit via optical amplification,” OSA Spotlight on Optics (2016).
- R. Horstmeyer, “Rank-Based Camera Spectral Sensitivity Estimation,” OSA Spotlight on Optics (2016).
- R. Horstmeyer, “Multilayer four-flux matrix model accounting for directional-diffuse light transfers,” OSA Spotlight on Optics (2016).
- R. Horstmeyer, “Spectral edge: gradient-preserving spectral mapping for image fusion,” OSA Spotlight on Optics (2015)
- R. Horstmeyer, “Matrix formalism for light propagation and absorption in thick textured optical sheets,” OSA Spotlight on Optics (2015)
- R. Horstmeyer, “Design and evaluation of a large-scale autostereoscopic multi-view laser display for outdoor applications,” OSA Spotlight on Optics (2014)
- R. Horstmeyer, “Large aperture adaptive doublet polymer lens for imaging applications,” OSA Spotlight on Optics (2014)
- R. Horstmeyer, “Multiview autostereoscopic projection display using a rotating screen,” OSA Spotlight on Optics (2013)
- R. Horstmeyer, “Nonimaging achromatic shaped Fresnel lenses for ultrahigh solar concentration,” OSA Spotlight on Optics (2013)
- R. Horstmeyer, “Multispectral integral imaging acquisition and processing using a monochrome camera and a liquid crystal tunable filter,” OSA Spotlight on Optics (2012)
- R. Horstmeyer, “Spectral imaging with synchronized capture and illumination,” OSA Spotlight on Optics (2012)
- R. Horstmeyer, “Re-designing the camera for computational photography,” SPIE Newsroom (2011)

### RELEVANT NEWS

- “Roarke Horstmeyer wins Charles Wiltz Prize” (link) *Caltech Electrical Engineering News* (2016)
- “Multiple scattering: Unravelling the tangle” (link) *Nature Physics* (2015)
- “Spotlight on graduate research” (link) *Caltech News* (2015)
- “Software: The computer will see you now” (link) *Nature* (2013)
- “One-Time Pad Reinvented to Make Electronic Copying Impossible” (link), *MIT Technology Review* (2013)
- “Digital camera add-on means the light’s fantastic” (link), *New Scientist* (2013)

## **FUNDING, SCHOLARSHIPS, AWARDS**

- 2016–2018: Einstein International Postdoctoral Fellowship (full funding)
- 2016: California Institute of Technology Charles Wiltz Doctoral Prize (for outstanding doctoral research)
- 2015: Caltech Everhart Lecture Award (for outstanding research and presentation)
- 2013–2015: California Institute of Technology I-Grant Program (2 years, \$125,000/year)
- 2011: MIT 100K Business Competition Linked Data Prize
- 2009–2012: National Defense Science and Engineering Graduate Fellowship (3 years, full funding)
- 2005–2007: Duke ECE Teaching Fellowship (NSF Graduate Teaching Fellowship)
- 2003–2004: Duke Naval Reserve Officer Training Corps Scholarship
- 2002–2003: Yoshi Hattori Memorial Scholarship for study in Japan
- 2003, 2004, 2006: Academic Dean's List
- National Physics Honor Society

## **PROFESSIONAL SERVICE**

- Official Panelist: OSA Spotlight on Optics
- Program committee: Computational Cameras and Displays (CCD) 2014, 2015, 2016
- Paper reviewer: Optica, Optics Express, Biomedical Optics Express, Optics Letters, Nature Communications, Nature Photonics, Journal of Applied Physics, Applied Physics Letters, JOSA A, Applied Optics, Optical Engineering, Optical Communications, PIERS, ACM SIGGRAPH, IEEE, Ultramicroscopy

## **LANGUAGES**

- Semi-fluent in Japanese
- Proficient at C++, JAVA & Matlab programming