

MEREDITH K. KUPINSKI, Ph.D.

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Bio-Sketch:

Meredith Kupinski joined the College of Optical Sciences at the University of Arizona (UA) in 2008 where she is now an Assistant Professor developing polarimetric instrumentation, polarized light scattering models, and polarization-aware computer vision and graphics capabilities. Being both an optical engineer and an image scientist, her research considers every aspect of the imaging chain: engineering requirements and optical design, uncertainty and statistics of calibration and data acquisition, and optical physics modeling. Dr. Kupinski's scientific contributions span various applications: the detection and characterization of abnormalities in medical imaging, estimating parameters to model the Earth's atmosphere in remote sensing, and computer vision classification. Dr. Kupinski was the recipient of a Science, Engineering, and Education for Sustainability (SEES) postdoctoral NSF fellowship to study polarimetry for aerosol science. In 2016, she was awarded a Jean d'Alembert visiting scholar position at École Polytechnic in France to work on Mueller polarimetry for cervical cancer detection. Her career goals include leveraging academic resources to build new opportunities for underrepresented students. Dr. Kupinski values multi-disciplinary experiences and exposure to diverse perspectives. She has authored over 20 peer-reviewed publications, 45 publications, and two patent applications. She earned a BS with Highest Honors in Imaging Technologies from the Rochester Institute of Technology and an MS and PhD in Optical Sciences from UA.

Education:

2003-2008	Ph.D.	Optical Sciences, University of Arizona, Tucson, AZ “Estimating Signal Features from Noisy Images with Stochastic Backgrounds for Tomographic Nuclear Medicine” Advisor: Harrison Barrett, UA Regents Professor
2001-2003	M.S.	Optical Sciences, University of Arizona, Tucson, AZ
1998-2001	B.S.	Imaging and Photographic Technologies with Highest Honors Rochester Institute of Technology, Rochester, NY

Employment:

2022- Present	Assistant Professor, Wyant College of Optical Sciences University of Arizona, Tucson, AZ
2010-2022	Full/Associate/Assistant Research Professor, Wyant College of Optical Sciences University of Arizona, Tucson, AZ

- 2008-2010 Director of Education, Center for Integrated Access Networks
National Science Foundation (NSF) Engineering Research Center
University of Arizona, Tucson, AZ
- 2002-2008 Graduate Research Assistant, Center for Gamma-Ray Imaging, Col-
lege of Optical Sciences
University of Arizona, Tucson, AZ
- 1999-2001 Image Quality Engineer, Eastman Kodak Company
Rochester, NY

Honors and Awards:

- 2022 University of Arizona “Women of Impact” ([link](#))
Awarded by home institution to 30 female faculty from 400 nominees.
- 2017 Jean d’Alembert Visiting Scholar for “Binary Classification of Polarimetric
Images for Cervical Cancer detection.”
Awarded by the French government to 3 applicants per year.
- 2013 NSF Fellow Science, Engineering and Education for Sustainability (SEES)
Supports crossing traditional disciplinary boundaries and allow early-career
scientists to investigate topics beyond their core disciplinary expertise.
- 2010 Women in Science and Engineering (WiSE) Mentoring Award
Nominated by UA students to honor outstanding contributions to promoting
the success of women in science and engineering.
- 2007 UA Foundation Outstanding Graduate Teaching Assistant
Based on a faculty nomination for assisting in new course development.
- 2006 Proposition 301 Imaging UA Fellowship
Awarded annually to select graduate students specializing in imaging.
- 2004 Rolyn Optics Graduate Teaching Assistant Award
Winners are chosen by student evaluations and faculty recommendations
- 2002 MaryJo Lake Graduate Fellowship
Awarded to one incoming female graduate student each year.

Service:

- 2021 - present SPIE Conference Co-chair: Measurement, Analysis, and Remote
Sensing, Optics and Photonics
- 2021 - present SPIE Conference Co-chair: Polarization Science and Remote Sens-
ing, Defense and Commercial Sensing
- 2021 - 2022 Developed and Taught Winter School Polarization Demonstration

2019	Guest Editor, Optical Engineering Special Edition on Polarization
2015 - 2016	Awarded RET supplement to work with 2 Native American teachers
2011 - present	NSF Computer and Information Science and Engineering (CISE) and NASA Earth Science review panels
2009 - present	Faculty advisor for Women in Optics (WiO) student group
2008	Taught a physics course at Diné College on the Navajo reservation

Courses Taught:

Spring 2022	OPTI 637: Principles of Image Science
Fall 2021	OPTI 604: Advanced Mathematical Methods for Optics
Spring 2021- Present	OPTI 586: Polarization in Optical Design
Fall 2018 - Present	OPTI 484/584: Polarized Light and Polarimetry

Patents:

2021	Method of Determining Fractional Contribution by Fresnel Reflection Using Two Measurements (pending)
2021	Incoherent Addition to Generalize Depolarization in Light Scattering Models (pending)

Original, Peer-reviewed Articles:

1. Shanks K, Parkinson J, Wu D, **Kupinski M.K.**, "*First LWIR Measurements of Cloud Polarization*", IEEE Trans Geoscience and Remote Sensing (in review)
2. Jarecki, Q., **Kupinski, M.K.**, "Underdetermined Polarimetric Measurements for Mueller Extrapolations," Optical Engineering (in review)
3. Omer K, **Kupinski M.K.**, "*Compression, Interpolation, and Importance Sampling for Polarized BRDF Models.*" Opt. Express 30, 25734-25752 (2022).
4. Clarkson E, **Kupinski M.K.** "*Effect on null spaces of list-mode imaging systems due to increasing the size of attribute space*" J. Opt. Soc. Am. A 38, 387-394 (2021).
5. Li L, **Kupinski M.K.** "*Merit functions and measurement schemes for single parameter depolarization models*" Opt. Express 29, 18382-18407 (2021).

6. E Clarkson and **Kupinski M. K.**, "Quantifying the loss of information from binning list-mode data," J. Opt. Soc. Am. A 37, 450-457 (2020).
7. Omer K, Caucci L, **Kupinski M.K.**, "Limitations of CNNs for Approximating the Ideal Observer Despite Quantity of Training Data or Depth of Network." J of Imag. Sci. and Tech 2020 November 06; 64(6):60408.
8. **Kupinski M.K.**, Li L, "Evaluating the Utility of Mueller Matrix Imaging for Diffuse Material Classification." J of Imag. Sci. and Tech. 2020 Nov 06; 64(6):60409.
9. Hart, K.A., **Kupinski, M.K.**, Wu, D.L. and Chipman, R., "First results from a Un-cooled LWIR Polarimeter for CubeSat Deployment" Opt. Eng. 59(7) 075103 (2020).
10. Zhan, H., Voelz, D.G. and **Kupinski, M. K.**, (2019). "Parameter-based imaging from passive multispectral polarimetric measurements." Optics Express, 27(20).
11. Bradley, C.L., Diner, D.J., Xu, F., **M. K. Kupinski** and Chipman, R.A., (2019). "Spectral Invariance Hypothesis Study of Polarized Reflectance With the Ground-Based Multiangle SpectroPolarimetric Imager." IEEE Transactions on Geoscience and Remote Sensing, 57(10).
12. **Kupinski, M. K.**, Bradley, C. L., Diner, D. J., Xu, F., & Chipman, R. A. (2019). "Angle of linear polarization images of outdoor scenes." Optical Engineering, 58(8).
13. **Kupinski, M. K.**, Bradley, C., Diner, D., Xu, F., & Chipman, R. (2019). "Estimating surface orientation from microfacet Mueller matrix bidirectional reflectance distribution function models in outdoor passive imaging polarimetry." Opt Eng, 58(8).
14. **Kupinski, M. K.**, Boffety, M., Goudail, F., Ossikovski, R., Pierangelo, A., Rehbinder, J., Vizet, J. and Novikova, T., (2018). "Polarimetric measurement utility for pre-cancer detection from uterine cervix specimens." Biomedical Optics Express, 9(11).
15. **Kupinski, M. K.**, Bankhead, J., Stohn, A., and Chipman, R. (2017). "Binary classification of Mueller matrix images from an optimization of Poincaré coordinates." JOSA A, 34(6).
16. **Kupinski, M. K.**, and E. Clarkson. (2016). "Optimal channels for channelized quadratic estimators" JOSA A, 33(6).
17. A. Könik, **Kupinski, M. K.**, P. H. Pretorius, M. A. King, and H. H. Barrett. (2015). "Comparison of the Scanning Linear Estimator (SLE) and ROI Uptake Estimation for Quantitative SPECT Imaging," Phy. in Med. and Bio. 60(16).
18. **Kupinski, M. K.**, and E. Clarkson. (2015). "Method for optimizing channelized quadratic observers for binary classification of large-dimensional image datasets," J.Opt.Soc. Am. A 32.
19. **Kupinski, M. K.**, R Chipman, and E Clarkson; (2014). "Relating the statistics of the angle of linear polarization to measurement uncertainty of the Stokes vector," Optical Engineering 53(11), 113108.

20. **Kupinski, M. K.**, E. Clarkson, and H. H. Barrett. (2013) “*Scanning linear estimation: improvements over region of interest (ROI) methods*,” *Physics in Medicine and Biology* 58, 1–19.
21. **Whitaker (Kupinski) M.**, E. Clarkson, and H. H. Barrett. (2008). “*Performance of linear and scanning-linear for signal location, size, and amplitude from noisy images with nuisance parameters*”, *Optics Express* Vol. 16, Issue 11.
22. H. H. Barrett, L. Furenlid, M. Freed, J. Hesterman, M. Kupinski, E. Clarkson, **M. Whitaker (Kupinski)**, (2008) “*Adaptive SPECT*”, *IEEE Trans on Med Imaging* 27.
23. M.B. Abbott, Y.A. DeClerk, Y-C. Chen, L. Furenlid, D. Wilson, G. Stevenson, **M. Whitaker (Kupinski)**, J. Woolfenden, R.A. Moats, and H. Barrett. (2007). “*100-micron resolution SPECT imaging of a neuroblastoma tumor model*,” *Molecular Imaging* 5, 214.

Conference Proceedings:

1. Hart Shanks, K.A, Chipman, R. John, J. Parkinson, J. Wu, D. **Kupinski M.K.**, "Near space demonstration of a compact LWIR spectro-polarimeter for ice cloud measurements," *Proc. SPIE 12112, Polarization: Measurement, Analysis, and Remote Sensing XV, 121120L* (3 June 2022);
2. Omer, K., **Kupinski M.K.**, "Physics-based rendering: simulated Mueller matrix imaging," *Proc. SPIE 12112, Polarization: Measurement, Analysis, and Remote Sensing XV, 121120F* (3 June 2022);
3. Jarecki, Q., **Kupinski M.K.**, "Extrapolating Mueller matrices from linear Stokes images," *Proc. SPIE 12112, Polarization: Measurement, Analysis, and Remote Sensing XV, 121120D* (3 June 2022);
4. Hart Shanks K., Chipman R., Wu D., **Kupinski M.K.**, "*Stokes resolved differential temperature: an important metric of polarimetric precision in the long-wave infrared*," *Proc. SPIE 11833, Polarization Science and Remote Sensing X*, (2021).
5. DeLeon C M., Heath J., Espinosa W.R., Wu D., **Kupinski, M.K.** "*UV linear stokes imaging of optically thin clouds*," *Proc. SPIE 11833, Polarization Science and Remote Sensing X*, (2021).
6. Omer K., Chipman, R., and **Kupinski, M. K.**, "*Detection enhancement using linear Stokes images on pre-trained neural networks*" *Proc. SPIE Polarization: Measurement, Analysis, and Remote Sensing XIV* (2020).
7. Li L., **Kupinski, M. K.**, and Chipman, R., "*Effects of Surface Roughness and Albedo on Depolarization in Mueller Matrices*" *Proc. SPIE Polarization: Measurement, Analysis, and Remote Sensing XIV* (2020).
8. Hart, K.A., **Kupinski, M. K.**, Wu, D.L. and Chipman, R., "*Linear Stokes measurement of thermal targets using compact LWIR spectropolarimeter*" *Proc. SPIE Polarization: Measurement, Analysis, and Remote Sensing XIV* (2020).
9. Omer, K., Caucci, L., and **Kupinski, M. K.**, "*Comparing training variability of CNN and optimal linear data reduction on image textures.*" In *IS&T International Symposium on Electronic Imaging, Computational Imaging* (Vol. 18).

10. Li, L. W., **Kupinski, M. K.**, Brown, M., & Chipman, R. A. "*Comparing classification performance of mueller matrix parameters for diffuse materials.*" In IS&T International Symposium on Electronic Imaging, Computational Imaging (Vol. 18).
11. J. B. Breckinridge, J. E. Harvey, R. Irvin, R. Chipman, **Kupinski, M. K.**, J. Davis, D-W. Kim, E. Douglas, C. F. Lillie, T. Hull, "*ExoPlanet Optics: conceptual design processes for stealth telescopes,*" Proc. SPIE 11115, UV/Optical/IR Space Telescopes and Instruments: Innovative Technologies and Concepts IX, 111150H (Sept 2019);
12. Hart, K.A., De Amici, G., Horne, T., **Kupinski, M. K.**, Langworthy, K., Stohn, A., Wu, D.L. and Chipman, R., 2019, September. "*Demonstration of LWIR channeled spectro-polarimeter.*" In Polarization Science and Remote Sensing IX (Vol. 11132, p. 1113207). International Society for Optics and Photonics.
13. Richter, J.M., Chipman, R., Daugherty, B., Diner, D.J., Eldering, A., Hyon, J.J., **Kupinski, M. K.**, Neu, J.L. and Fu, D., 2019. "*Specifying polarimetric tolerances of a high-resolution imaging multiple-species atmospheric profiler (HiMAP).*" In Photonic Inst Eng VI (Vol. 10925, p. 109250F). International Society for Optics and Photonics.
14. Davis, J., **Kupinski, M. K.**, Chipman, R.A. and Breckinridge, J.B., 2018. "*HabEx polarization ray trace and aberration analysis.*" In Space Telescopes and Instrumentation 2018: Optical, Infrared, and Millimeter Wave (Vol. 10698, p. 106983H). International Society for Optics and Photonics.
15. **Kupinski, M. K.**, J. Rehbinder, H. Haddad, S. Deby, J. Vizet, B. Teig, A. Nazac, A. Pierangelo, F. Moreau, and T. Novikova, "*Tasked-based quantification of measurement utility for ex vivo multi-spectral Mueller polarimetry of the uterine cervix,*" in Clinical and Preclinical Optical Diagnostics, J. Brown, ed., Vol. 10411 of SPIE Proceedings (OSA, 2017), paper 104110N.
16. Vanderbilt, V., Daughtry, C., **Kupinski, M. K.**, Bradley, C., French, A., Bronson, K., Chipman, R. and Dahlgren, R., 2017, August. "*Estimating the relative water content of leaves in a cotton canopy.*" In Polarization Science and Remote Sensing VIII (Vol. 10407, p. 104070Z). International Society for Optics and Photonics.
17. **Kupinski, M. K.**, Chipman, R. A., "*Power Spectra Trends in Imaging Polarimetry of Outdoor Solar Illuminated Scenes,*" Proc. SPIE Polarization: Measurement, Analysis, and Remote Sensing XII (2016).
18. **Kupinski, M. K.**, Clarkson, E., Ghaly, M. & Frey, E., "*Applying the J-Optimal Channelized Quadratic Observer to a SPECT Phantom for Myocardial Perfusion Defect Detection*" Medical Imaging: Image Perception, Observer Performance, and Technology Assessment. SPIE, Vol. 9787. 978708 (2016).
19. **Kupinski, M. K.**, Bradley, C. L., Diner, D. J., Xu, F., and Chipman, R. A., "*Estimating Surface Orientation in Imaging Polarimetry of Solar Illuminated Outdoor Scenes,*" Proc. American Geophysical Union (AGU) Fall Meeting (2015).
20. Bradley, C. L., **Kupinski, M. K.**, Diner, D. J., Xu, F., and Chipman, R. A., "*Polarization Ray Tracing Calculation of Polarized Bidirectional Reflectance Distribution Function (pBRDF) of Microfaceted Surfaces to Investigate Multiple Reflection Effects,*" Proc. American Geophysical Union (AGU) Fall Meeting (2015).

21. Diner D., Bradley C., Bull M., Chipman R., Davis A., Garay M., Jovanovic V., Kalashnikova O., **Kupinski M. K.**, Rheingans B., Seidel F., van Harten G., and Xu F., “*Progress in Photoelastic Modulator-Based Spectropolarimetric Imaging of Aerosols and Clouds*,” Proc. Am Geophysical Union (AGU) Fall Meeting (2015).
22. Vanderbilt V., Daughtry C., **Kupinski M. K.**, Bradley C., Dahlgren R., “*Coming of Age: Polarization as a Probe of Plant Canopy Water Status*,” Proc. American Geophysical Union (AGU) Fall Meeting (2015).
23. **Kupinski, M. K.**, Bradley, C. L., Diner, D. J., Xu, F., and Chipman, R. A., “*Applying a Microfacet Model to Polarized Light Scattering Measurements of the Earths Surface*,” Proc. SPIE Polarization Science and Remote Sensing VII (9613) (2015).
24. Bradley, C. L., **Kupinski, M. K.**, Diner, D. J., Xu, F., and Chipman, R. A., “*Spectral invariance hypothesis study of polarized reflectance with Ground-based Multian-gle SpectroPolarimetric Imager (GroundMSPI)*,” Proc. SPIE Polarization Science and Remote Sensing VII (9613) (2015).

Invited Talks:

1. “Deployment of Prototype Instruments for Observing Earth’s Atmosphere,” American Indian Science and Engineering Society, Palm Springs, CA (2022).
2. “First High-Altitude LWIR of Measurement of Cloud Top Polarization,” Gordon Conference on Emerging Imaging Techniques at the Intersection of Physics and Data Science, Newry, ME, (2022).
3. “Polarization in Nature,” Guest Lecture for University of Rochester (2021).
4. “Adaptive Partial Polarimetry for Cancer Detection,” IV Symp on Optics and Biophotonics, and the International School for Junior Scientists, Russia, (2017).
5. “Angle of Linear Polarization Images of Outdoor Sciences,” Colloquium Series, University of Rennes, France, (2017).
6. “Quadratic Binary Detection Algorithms for Large-Dimensional Image Data,” Colloquium Series, École Polytechnic, France, (2015).
7. “Physical Parameter Retrieval from Imaging Polarimetry,” Brown Bag Academic Partnerships, National Geospatial-Intelligence Agency (NGA), (2015).
8. “Scanning Linear Estimators for Nuclear Medicine,” Radiology Research Seminar Series, University of Massachusetts Medical School, (2014).
9. “Relating the Statistics of the Angle of Linear Polarization (AoLP) to Measurement Uncertainty of the Stokes Vector,” Polarimetric Techniques & Technology Workshop, Leiden, The Netherlands, (2014).
10. “Estimation Tasks in Emission Tomography,” Rochester Institute of Technology Center for Imaging Science Colloquium, (2012).
11. “Mutual Information to Explore Unique Estimability of Polarimetric Datasets,” Pan-American Advanced Studies Institute on Frontiers in Imaging Science, Bogotá, Colombia, (2011).
12. “Classroom Integration of Indigenous Knowledge and Physics”; American Indian Science and Engineering Society, (2011).