MARK F. SPENCER
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SUMMARY

Mark F. Spencer is currently a Professor of Optical Sciences and the inaugural holder of the Robert M. Edmund Endowed Chair in Optical Sciences within the James C. Wyant College of Optical Sciences at the University of Arizona. At large, he is a scientist/engineer who has spent his career working in various technical and administrative capacities. He began his research career at the Air Force Research Laboratory, Directed Energy Directorate (2014-2021) after receiving his PhD from the Air Force Institute of Technology (AFIT) in Optical Sciences and Engineering with the support of a Science, Mathematics, and Research for Transformation (SMART) Scholarship. Before taking his current role in academia, he served as a Directed Energy Staff Specialist at Headquarters U.S. Indo-Pacific Command (2021-2023), as well as the Director of the Joint Directed Energy Transition Office and the Principal Director (Senior Official) for Directed Energy at the Pentagon within the Office of the Under Secretary of Defense for Research and Engineering (2023-2025).

Prof. Spencer is an internationally recognized expert in directed energy (specifically, beam control and propagation for laser systems) with over 150 peer-reviewed technical publications, including 1 textbook, 1 book chapter, 3 U.S. Patents, 71 journal articles, and 91 conference papers. He currently conducts research in unconventional imaging, sensing, and adaptive optics for defense and commercial applications. In support, Prof. Spencer is an active member of the Directed Energy Professional Society (DEPS) and the Military Sensing Symposia (MSS), a senior member of Optica (the society advancing optics and photonics worldwide), and a fellow of SPIE (the international society for optics and photonics). He is the recipient of several awards, including a 2018 SPIE Rising Researcher Award, a 2020 AFRL Early Career Award, a 2022 AFIT Young Alumni Award, and a 2022 Joint Civilian Service Achievement Award.

EDUCATION

Air Force Institute of Technology — Dayton, OH
PhD, Optical Sciences and Engineering — Jun 2014
Dissertation: *The Scattering of Electromagnetic Beam Illumination from Statistically Rough Surfaces*
Advisor: Milo W. Hyde IV

MS, Optical Sciences and Engineering — Mar 2011
Thesis: *Branch Point Mitigation of Thermal Blooming Phase Compensation Instability*
Advisor: Salvatore J. Cusumano

University of Redlands — Redlands, CA
BS, Physics; Minor, Mathematics (*magna cum laude*) — May 2008
Honors Thesis: *Stimulated Brillouin Scattering (SBS) Threshold in Optical Fibers*
Advisor: Allan J. DeWeerd

EXPERIENCE

University of Arizona, James C. Wyant College of Optical Sciences Tucson, AZ
Robert M. Edmund Endowed Chair and Professor, Optical Sciences Aug 2025-Present

- Sustains a vital and innovative portfolio of extramural research
- Participates with distinction in both undergraduate and graduate education, including classroom teaching, as well as mentoring and advising students in research

Office of the Under Secretary of Defense for Research and Engineering Washington, DC
Acting Principal Director, Directed Energy Jan 2025 – Aug 2025

- Served as the senior official for directed energy within the Department of Defense (DoD)
- Oversaw the DoD Directed Energy Roadmap, which at the time provided the strategy and vision for annual investments totaling more than $1B across the Department

Director, Joint Directed Energy Transition Office Apr 2023 – Aug 2025

- Served as an internationally recognized expert in directed energy
- Executed an annual budget of $200M that funded research and prototype projects with academic, industry, and government partners (both domestic and international)

Air Force Institute of Technology, Department of Engineering Physics Dayton, OH
Adjunct Associate Professor, Optical Sciences and Engineering Mar 2021-Aug 2025

- Advised/co-advised/sponsored MS and PhD students at multiple universities
- Taught short courses and gave invited talks on beam control, deep turbulence, and digital holography to international audiences at conferences and workshops

Adjunct Assistant Professor, Optical Sciences and Engineering Mar 2015-Feb 2021

- Co-advised/sponsored MS and PhD students at multiple universities
- Taught short courses on linear systems in optics, beam control, and digital holography, as well as a special study on speckle in wavefront sensing

U.S. Indo-Pacific Command, Science and Technology Division Oahu, HI
Directed Energy Staff Specialist Jul 2021-Mar 2023

- Served as the principal advisor on high energy laser and high power microwave systems
- Aided the transition of directed energy, laser communication, and over the horizon radar capabilities to the Indo-Pacific area of responsibility with international allies and partners

Air Force Research Laboratory, Directed Energy Directorate Albuquerque, NM
Senior Research Physicist Jan 2019-Jun 2021

- Served as the principal investigator for aero effects and beam control
- Led a diverse research team in the development of novel theory, high-fidelity M&S, laboratory experiments, and field tests with an annual budget of $10M

Research Physicist Jun 2014-Dec 2018

- Led a robust research portfolio in advanced sensing using digital holography

- Developed a state-of-the-art beam control and propagation laboratory

EXPERIENCE (Committees and Working Groups)

Breakthrough Initiatives Palo Alto, CA
Breakthrough Starshot Advisory Committee, Photon Engine Subcommittee Jul 2016 – Apr 2023
- Participated in kind as a subject matter expert in laser phased arrays
- Helped establish technical requirements and guide 10 phase I efforts

Joint Directed Energy Transition Office Albuquerque, NM
Air Force Rep, Atmospheric Propagation Technical Area Working Group Sep 2014 – Dec 2020
- Served as the Chair in 2020 and Vice Chair in 2019
- Led atmospheric propagation R&D with a tri-service group and $2.0M annual budget

EXPERIENCE (Classroom Teaching)

University Courses
OPTI TBD – Laser Beam Control and Propagation Fall 2026 (Projected)
- Instructor for a new 3-unit, 15-week, graduate-level specialty course at the U of Arizona

OPTI TBD – Computational Wave-Optics Lab Fall 2026 (Projected)
- Instructor for a new 3-unit, 15-week, graduate-level lab course at the U of Arizona

OPTI 505R – Interference and Diffraction Spring 2026 – Present
- Instructor for a 3-unit, 15-week, graduate-level core course at the U of Arizona

OPTI 505L – Fundamentals of Physical Optics Lab Spring 2026 – Present
- Instructor for a 1-unit, 15-week, graduate-level lab course at the U of Arizona

OENG 899 – Doctoral Level Special Study on "Speckle in Wavefront Sensing" Spring 2016
- Instructor for a 4-unit, ten-week, graduate-level specialty course at AFIT

PHYS 640 – Optics I Fall 2011
- Teaching assistant for a 4 unit, ten-week, Graduate-level prerequisite course at AFIT

PHYS 220 – Fundamentals of Physics I and II Spring 2006 – Fall 2008
- Teaching assistant for a 4-unit, 14 week, undergraduate-level laboratory course at the U of Redlands

PHYS 101 – Physics for Poets Fall 2006
- Teaching assistant for a 4-unit, 14 week, undergraduate-level general education course at the U of Redlands

Short Courses
Deep-Turbulence Limitations (taught 5 times) Fall 2022 – Present
- Half-day short course follows the material presented in authored publications

Advanced Sensing Using Digital Holography (taught 4 times) Spring 2021 – Present
- Half- or full-day short course follows the material presented in an authored book chapter

Digital Holography Short Course Winter 2021
- 8, 2-hour, graduate-level virtual lectures

Fundamentals of Beam Control Summer 2019
- 26, 2-hour, graduate-level lectures at Kirtland AFB

Beam Control for Laser Systems (taught 8 times) Spring 2018 – Present

- Half- or full-day short course follows the material presented in an authored textbook

Linear Systems in Optics Spring 2015

- 16, two-hour, graduate-level lectures at Kirtland AFB

EXPERIENCE (Mentoring and Advising)

Doctoral Students

Ryan McCrory, U of Arizona Spring 2029 (Projected)

- Primary Advisor
- Current topic: Tiled array feedback for high energy laser systems

Ian Kingsolver, U of Arizona Spring 2029 (Projected)

- Primary Advisor
- Current topic: Jitter coupling in active imaging

Nicolas Malamug, U of Arizona Spring 2029 (Projected)

- Primary Advisor
- Current topic: Benchtop atmospheric turbulence simulator

Justin Barnes, U of Arizona Spring 2028 (Projected)

- Primary Advisor
- Current topic: Branch-point tolerant phase reconstruction

Kyle Ettinger, U of Arizona Fall 2027 (Projected)

- Primary Advisor
- Current topic: Vibration imaging using digital-holographic detection

Lisset Ayala, U of Arizona Spring 2027 (Projected)

- Co-advising with Mehmetcan Akbulut
- Current topic: Digital-holographic detection with an engineered reference beam

Peter Dean-Erlander, U of Arizona Spring 2027 (Projected)

- Co-advising with Ron Driggers
- Current topic: Downlink speckle mitigation in active imaging

Wesley Barnes, U of Alabama Huntsville Spring 2027 (Projected)

- Primary Advisor
- Current topic: Dual-wavelength atmospheric turbulence simulator
- Current employment with U.S. Army SMDC

Joshua Teague, U of Arizona Spring 2027 (Projected)

- Co-advising with Ron Driggers
- Current topic: Electronic FMCW active imaging

Eric Mitchell, PhD Student, U of Arizona Spring 2026 (Projected)

- Co-advising with Ron Driggers
- Dissertation title: "Coherent effects and radiometry considerations in active imaging"
- Current employment with U.S. Army SMDC

Joshua Follansbee, U Arizona Fall 2024

- Committee member
- Dissertation title: "*Active Targeting in the SWIR and eSWIR*"
- Follow-on employment with MIT-LL

Derek Burrell, U of Arizona Summer 2023

- Co-advised with Ron Driggers
- Dissertation title: "*Speckle Phenomena in Active Electro-Optical Applications*"
- Follow-on Fulbright Postdoctoral Fellowship

Matthias Banet, U of Rochester Spring 2023
- Co-advised with James Fienup via a SMART Scholarship
- Dissertation title: "*Wavefront sensing the 3D image reconstruction in deep turbulence*"
- Follow-on employment with AFRL/RD

Steven Owens, AFIT Summer 2022
- Co-advised with Glen Perram
- Dissertation title: "*Efficiency Quantification for Pulsed-Source Digital Holography*"
- Follow-on Air Force assignment to the NRO

Jeffrey Beck, Michigan Tech Spring 2020
- Dissertation Sponsor
- Dissertation title: "*Saturation Behaviors in Deep Turbulence*"
- Follow-on employment with nLight Defense Systems

Douglas Thornton, AFIT Summer 2019
- Co-advised with Glen Perram
- Dissertation title: "*Digital Holography Efficiency Experiments for Tactical Applications*"
- Follow-on Air Force assignment to the NRO

Casey Pellizzari, Purdue Spring 2017
- Dissertation Sponsor
- Dissertation title: "*Optically-Coherent Sensing and Imaging: A Model-Based Approach*"
- Follow-on assignment to Air Command and Staff College

Sennan Sulaiman, UCLA Fall 2017
- Dissertation Sponsor
- Dissertation title: "*Predictive Dynamic Digital Holography*"
- Follow-on employment with Northrop Grumman

Noah Van Zandt, AFIT Summer 2017
- Co-advised with Steven Fiorino
- Dissertation title: "*The Benefits of Polychromatic Speckle Mitigation for Shack Hartmann Wavefront Sensors*"
- Follow-on employment with AFRL/RD

<u>Master's Students</u>

John Cobes, U of Arizona Spring 2027 (Projected)
- Primary Advisor for MS Thesis
- Current topic: Non-common path phase errors in adaptive optics

Jordin Francis, U of Arizona Spring 2027 (Projected)
- Primary Advisor for MS Thesis
- Current topic: Efficient modeling of steady state thermal blooming

Trevor Owens, U of Arizona Fall 2026 (Projected)
- Primary Advisor for MS Thesis
- Current topic: Uplink scintillation mitigation in active imaging

Shirley Govea-Bravo, U of Arizona Summer 2026 (Projected)
- Primary Advisor for MS Thesis

- Current topic: Effects of speckle and scintillation on lidar systems

Adam Lane, U of Arizona — Spring 2026 (Projected)
- Primary Advisor for MS Report
- Current topic: Large aperture reflective inflatable optics

Zachary Watson, U of Arizona — Spring 2026 (Projected)
- Primary Advisor for MS Thesis
- Current topic: Characterization of an event based sensor

Benjamin Wilson, AFIT — Spring 2024
- Thesis Sponsor
- Thesis title: "*Remote profiling of atmospheric turbulence: enhanced resolution with stacked Raleigh beacons in TARDIS*"
- Follow-on employment with NSWCDD

Derek Burrell, U of Central Florida — Spring 2020
- Co-advised with Ron Driggers via a SMART Scholarship
- Thesis title: "*Wave-optics Simulation of Correlated Speckle Fields*"
- Follow-on employment with AFRL/RD

Davin Mao, AFIT — Winter 2019
- Co-advised with Glen Perram
- Thesis title: "*Effects of Sinusoidal Phase Modulation on Signal-to-Noise Ratio in a Digital Holography System*"
- Follow-on Air Force assignment to the NRO

Casey Pellizzari, Air Command and Staff College — Spring 2018
- Primary Advisor
- Thesis title: "*Deep-Atmospheric-Turbulence Mitigation for Imaging and Wavefront Sensing*"
- Follow-on assignment to the U.S. Air Force Academy

Ann Lanari, AFIT — Winter 2017
- Committee Member
- Thesis title: "*Numerical Wave Optics Investigation of Optical Scatter from Statistically Rough Surfaces*"
- Follow-on assignment to the U.S. Air Force Academy

Matthew Gridley, AFIT — Winter 2015
- Committee Member
- Thesis title: "*Experimental Method of Generating Electromagnetic Gaussian Schell-Model Beams*"
- Follow-on Air Force assignment to the NRO

<u>Government Programs</u>

AFRL Summer Fellowship Program (Sponsored 1 Professor, 1 Grad Student)	Summer 2020
Premier College Internship Program (Mentored 1 Undergrad Student)	Summer 2020
SMART Scholarship Program (Mentored 3 Grad Students)	2016 – 2022
AFRL Scholars Program (Managed 25 Grad and Undergrad Internships)	2015 – 2023
U of New Mexico STEM Mentoring Program (Mentored 7 Undergrad Students)	2015 – 2020

EXPERIENCE (Internships and Assistantships)

Air Force Research Laboratory, Directed Energy Directorate Maui, HI
SMART Scholar Intern Fall 2012 and 2013

- Developed wave-optics tools for a deep-space inverse synthetic aperture lidar system

Air Force Research Laboratory, Directed Energy Directorate Albuquerque, NM
Summer Intern Summer 2011

- Quantified the effects of stair mode in laser phased arrays

Air Force Institute of Technology, Department of Engineering Physics Dayton, OH
Research Assistant, Center for Directed Energy Jan 2009 – Jun 2014

- Completed research towards: (1) PhD dissertation, (2) Phase I STTR, and (3) MS thesis

University of Arizona, College of Optical Sciences Tucson, AZ
Research Assistant, Fiber Laser Group Fall 2008

- Setup diagnostic equipment and collected data on novel bandgap fibers

Lawerence Livermore National Laboratory Livermore, CA
Summer Intern Summer 2008

- Added a thermal conduction calculation to a massively parallel astrophysics code

Air Force Institute of Technology, Department of Engineering Physics Dayton, OH
Directed Energy Summer Intern Summer 2007

- Built a 75W narrowband fiber laser and measured SBS threshold in multiple fibers

University of Redlands, Department Physics Redlands, CA
Summer Intern Summer 2006

- Designed and built the mechanical components for a scanning tunneling microscope

LICENSES and CERTIFICATIONS

Certified Practitioner, Engineering and Technical Management	2022
Fellow, Indo-Pacific Orientation Course, Asia Pacific Center for Security Studies	2021
TS Clearance	Indoctrinated 02 Mar 2021

HONORS and AWARDS

Air Force Institute of Technology Young Alumni Award	2022
Joint Civilian Service Achievement Award	2022
Air Force Research Laboratory, Directed Energy Directorate Civilian of the Quarter	2022
SPIE Fellow	2022
Air Force Research Laboratory, Directed Energy Directorate Annual Mentorship Award	2021
Air Force Research Laboratory Early Career Award	2020
Optica Senior Member	2020
SPIE Community Champion	2019 and 2020
Air Force Scientific Advisory Board Best Presentation	2019
Optica Top 200 Journal Referee Appreciation	2018
SPIE Rising Researcher Award	2018

Air Force Research Laboratory Annual Commander's Cup Junior Individual Award 2017
Air Force Research Laboratory, Directed Energy Directorate Annual Director's Cup Junior Force Award 2017
Air Force Research Laboratory, Directed Energy Directorate Annual Mentorship Award 2016
SPIE Senior Member 2016
Air Force Research Laboratory Scholars Program Outstanding Mentor Award 2016
Air Force Research Laboratory, Directed Energy Directorate Civilian of the Quarter 2015
Air Force Institute of Technology Civilian Student of the Year Award 2013
Air Force Institute of Technology Civilian Student of the Quarter 2013
Air Force Institute of Technology Civilian Student of the Quarter 2012
Science, Mathematics, and Research for Transformation (SMART) Scholarship 2011 – 2014
Directed Energy Professional Society Graduate Scholarship 2010, 2011, and 2012
SPIE Scholarship in Optical Sciences and Engineering 2010 and 2012
SPIE Scholarship in Optics and Photonics 2011
Dayton Area Graduate Studies Institute Scholarship 2009 – 2011
University of Redlands, Robert D. Engel Award 2008

HONOR SOCIETIES

Tau Beta Pi, Engineering Honor Society 2009
Phi Beta Kappa Society, Liberal Arts and Sciences Honor Society 2008
Omicron Delta Kappa, Leadership Honor Society 2008

PROFESSIONAL SOCIETIES

MSS – Military Sensing Symposia 2019 – Present
- Plenary Speaker, Active E-O Systems Conference 2024
- Tutorial Instructor, Active E-O Systems Conference 2022
- Program Committee, Active E-O Systems Conference 2020 – Present
- Invited speaker, Active E-O Systems Conference 2019

Optica – the Society Advancing Optics and Photonics Worldwide 2010 – Present
(formerly the Optical Society of America – OSA)
- Lifetime Member and Senior Member
- Invited Speaker, Online Meeting on Defense & Security 2025
- Top Contributor, Institutional Focus Issue of Applied Optics, U.S. Air Force Institute of Technology (3 papers) 2025
- Invited Tutorial Author, JOSA A 2024
- Associate Editor, Applied Optics Jan 2023 – Present
- Lead Editor, Feature Issue of Applied Optics, Application of Lasers for Sensing and Free Space Communications Jan 2023 – Aug 2023
- Short-Course Instructor, Laser Congress 2022
- Program Committee, Application of Lasers for Sensing and Free Space Communications (LS&C) 2022 – 2024
- Webinar and Social-Media Officer, Laser Systems Technical Group 2022 – 2023
- Issue Organizer, Institutional Focus Issue of Applied Optics, U.S. Air Force Research Laboratory 2021

- Invited Speaker, pcAOP and LS&C 2019, 2021, and 2022
- Chair, Laser Systems Technical Group 2019 – 2021
- Program Committee, Propagation Through and Characterization of Atmospheric and Oceanic Phenomena (pcAOP) 2016 – 2018, 2020, 2021
- Reviewer, Applied Optics, JOSA A, Optics Express, Optics Letters, Optics Continuum, and Optica (70 reviews) 2015 – 2023
- Author, Applied Optics, JOSA A, Optics Express, and Optics Letters 2013 – Present

SPIE – the International Society for Optics and Photonics 2009 – Present
(formerly the Society of Photographic Instrumentation Engineers)

- Lifetime Member and Fellow
- Short-Course Instructor, Defense + Security 2026
- Keynote Speaker, Pacific Rim Security + Defence 2024
- Keynote Speaker, Photonics Industry Summit 2024
- Program Committee, Unconventional Imaging, Sensing, and Adaptive Optics 2024 – Present
- Keynote Speaker and Panelist, Defense + Commercial Sensing 2024
- Chair, Unconventional Imaging, Sensing, and Adaptive Optics 2020 – 2023
- Member, Scholarship Committee 2019 – 2021
- Co-Chair, Unconventional and Indirect Imaging, Image Reconstruction, and Wavefront Sensing 2019
- Career Lab Leader 2018
- Invited speaker, Defense + Security 2017
- Reviewer, Optical Engineering 2016 – Present
- Program Committee, Unconventional and Indirect Imaging, Image Reconstruction, and Wavefront Sensing 2016 – 2018
- Member, Information Technology Committee 2016 – 2018
- Member, Membership and Communities Committee 2015 – 2017
- Science Fair Judge 2012 and 2013
- Facilitator, Student Chapter Leadership Workshops 2010, 2012, and 2014
- Outreach Lead, AFIT SPIE Student Chapter 2011 – 2020
- Author, Optical Engineering 2010 – Present
- Secretary, AFIT SPIE Student Chapter 2010 – 2011
- Founding President, AFIT SPIE Student Chapter 2009 – 2010

DEPS – Directed Energy Professional Society 2007 – Present

- Plenary Speaker, Test and Evaluation Symposium 2025
- Plenary Speaker, Annual S&T Symposium 2023 and 2024
- Plenary Speaker, UK/US Workshop 2022
- Virtual Science Fair Judge 2021
- Short-Course Instructor at Symposia (12 courses taught to date) 2018 – Present
- Textbook Author, “Beam Control for Laser Systems, 2nd Edition” 2018
- Invited speaker, Annual S&T Symposium 2018
- Program Committee, Beam Control, Annual S&T Symposium 2016

PUBLICATIONS

Citations: 1,722; H-Index: 23; i10-Index: 58

Summary: 1 Textbook, 1 Book Chapter, 3 Patents, 1 Patents in Review, 71 Journal Articles (with 10 Editor's Picks, 2 invited, and 1 Spotlight on Optics), 4 Journal Articles in Review, 5 Conference Plenaries, 5 Conference Keynotes, 91 Conference Papers (with 5 Invited), 30 First-Author Conference Presentations (with 7 Invited), 1 News Article, 1 Technical Report, 1 PhD Dissertation, 1 MS Thesis, and 1 Undergraduate Honors Thesis

Textbook

P. H. Merritt and M. F. Spencer, Beam Control for Laser Systems, 2nd Edition, Directed Energy Professional Society, Albuquerque, NM (2018).

Book chapter

M. F. Spencer, "Spatial Heterodyne," in Encyclopedia of Modern Optics, 2nd Edition, Bob Guenther and Duncan Steel, Eds., Elsevier, Amsterdam, The Netherlands (2018).

Patents

[3] C. J. Pellizzari, Timothy J. Bate, and M. F. Spencer, "Methods for Measuring Optical-Phase Information and for Producing Focused, Reduced Speckle Images from Active Illumination and Direct Detection," U.S. Patent 12,513,419 (17 December 2025).
[2] C. J. Pellizzari, M. F. Spencer, and C. A. Bouman, "Method of Single Shot Imaging for Correcting Phase Errors," U.S. Patent 10,591,871 (17 March 2020).
[1] C. J. Pellizzari, M. F. Spencer, and C. A. Bouman, "Single Shot Imaging Using Digital Holography Receiver," U.S. Patent 10,416,609 (17 September 2019).

Patents in Review

[1] C. J. Pellizzari, Timothy J. Bate, and M. F. Spencer, "Imaging Sensors for Measuring Optical-Phase Information and for Producing Focused, Reduced Speckle Images from Active Illumination and Direct Detection," U.S. Patent Pending (Submitted 4 Jan 2024).

Journal Articles

[71] M. W. Hyde IV, M. F. Spencer, and M. Kalensky, "Generating multi-wavelength phase screens for atmospheric wave optics simulations using fast Fourier transforms," Accepted in J. Opt. Soc. Am. A (2025).
[70] P. Dean-Erlander, A. Hendrick, J. Teague, M. Spencer, and R. Driggers, "Human and Algorithmic Imaging Performance in the Presence of Speckle," Accepted in Opt. Eng. (2025).
[69] M. Kalensky, M. T. Banet, T. J. Bukowski, E. M. Bates, M. W. Hyde IV, and M. F. Spencer, "Benchtop implementation of branch-point-tolerant adaptive optics," Appl. Opt. 65(19), H1-H13 (2025).
[68] M. W. Hyde IV, R. G. Bedford, E. V. Poutrina, J. D. Leger, M. F. Spencer, and A. Ahmadavand, "Experimental generation of partially coherent Besinc pseudo-Schell model sources using a digital micromirror device: comment," J. Opt. Soc. Am. B 43(2), 309-311 (2025).

[67] J. Teague, O. Furxhi, M. Akbulut, M. F. Spencer, C. K. Renshaw, and R. G. Driggers, "Performance characterization of electronic FMCW active imagers," Appl. Opt. 64(28), 8360-8369 (2025).
[66] M.W. Hyde IV, E. W. Mitchell, and M. F. Spencer, "Closed-form expressions for the centroid-tilt error due to scintillation," Optics and Lasers in Engineering 194, 109166 (2025).
[65] E. W. Mitchell, D. Burrell, M. W. Hyde, R. G. Driggers, and Mark F. Spencer, "Scaling laws for the noise-equivalent angle and C-tilt, G-tilt anisoplanatism due to scintillation: errata," Appl. Opt. 64(16), 4461-4463 (2025).
[64] C. J. Pellizzari, A. M. Weaver, T. J. Hardy, and M. F. Spencer, "Neural Image Sharpening: A framework for volumetric wavefront sensing and imaging," Appl. Opt. 64(18), E92-E100 (2025).

- Editor's Pick

[63] E. W. Mitchell, D. Burrell, M. W. Hyde, R. G. Driggers, and Mark F. Spencer, "Scaling laws for the noise-equivalent angle and C-tilt, G-tilt anisoplanatism due to scintillation," Appl. Opt. 64(18), E11-E19 (2025).

- Editor's Pick

[62] M. Kalensky, D. J. Burrell, M. T. Banet, and M. F. Spencer, "Hidden-phase compensation in extended-beacon adaptive optics," Appl. Opt. 64(18), E1-E10 (2025)

- Editor's Pick

[61] J. Teague, O. Furxhi, J. Follansbee, M. F. Spencer, R. G. Driggers, "Performance comparison of continuous-wave and laser range-gate with continuous-wave time-of-flight and laser range-gate with range resolve active imaging systems," Opt. Eng. 63(12) 123102 (2024).
[60] M. Kalensky, D. Getts, M. T. Banet, D. J. Burrell, M. W. Hyde, and M. F. Spencer, "Limitations of beam-control compensation," Opt. Express 32(24), 42301-42317 (2024).
[59] M. Kalensky, S. Gordeyev, M. R. Kemnetz, and M. F. Spencer, "Aero-optical effects, part II. Sources of aberrations: tutorial," J. Opt. Soc. Am. A 41(11), 2175-2187 (2024)

- Invited

[58] M. Kalensky, S. Gordeyev, M. R. Kemnetz, and M. F. Spencer, "Aero-optical effects, part I. System-level considerations: tutorial," J. Opt. Soc. Am. A 41(11), 2163-2174 (2024)

- Editor's Pick, Invited

[57] D. J Burrell, M. F Spencer, and R. G Driggers, "Closed-loop adaptive optics in the presence of speckle and weak scintillation," J. Opt. 26(11), 115608 (2024).
[56] D. J. Burrell, M. F. Spencer, R. G. Driggers, "Open-loop wavefront sensing in the presence of speckle and weak scintillation," Optics Communications 572, 130960 (2024).
[55] M. Kalensky, M. W. Hyde, D. Getts, and M. F. Spencer, "Impact of exposure time on optical-phase measurements," J. Opt. Soc. Am. A 41(8), 1441-1451 (2024).
[54] M. W. Hyde, M. Kalensky, and M. F. Spencer. "Phase error scaling law in two-wavelength adaptive optics," IEEE Photonics Technology Letters 36(12), 779-782 (2024).
[53] C. J. Pellizzari, T. J. Bate, M. G. Mandyam, C. J. Radosevich, S. Horst, and M. F. Spencer, "Speckle-free coherent imaging through deep turbulence," Opt. Lett. 49(12), 3508-3511 (2024).
[52] D. C. Dayton and M. F. Spencer, "Scaled-laboratory demonstrations of deep-turbulence conditions," Appl. Opt. 63(16), E54-E63 (2024).
[51] M. Kalensky, D. Getts, and M. F. Spencer, "Tracking bandwidth limitations for strong optical-turbulence conditions," Opt. Lett. 49(8), 2081-2084 (2024).
[50] M. W. Hyde, J. E. McCrae, M. Kalensky, and M. F. Spencer, ""Hidden phase" in two-wavelength adaptive optics," Appl. Opt. 63(16), E1-E9 (2024).

- Editor's Pick

[49] D. Burrell, J. Follansbee, O. Furxhi, M. F. Spencer, J. Lund, K. Renshaw, R. Driggers, "Performance benefits of charge-domain gain in active SWIR targeting," Opt. Eng. 63(1), 013104 (2024).
[48] T. E. DeFoor, M. Kalensky, M. R. Kemnetz, T. J. Bukowski, and M. F. Spencer, "Shock-wave tolerant phase reconstruction algorithm for Shack–Hartmann wavefront sensor data," Opt. Eng. 23(12), 123103 (2023).
[47] D. Burrell, J. H. Follansbee, M. F. Spencer, and R. G. Driggers, "System-level noise performance of coherent imaging systems," Opt. Express 31(23), 38625-38639 (2023).
[46] M. W. Hyde IV and M. F. Spencer, "Spatiotemporal optical vortices in atmospheric turbulence," Waves in Random and Complex Media, 1-27 (2023).
[45] M. F. Spencer, M. W. Hyde IV, S. Bose-Pillai, and M. A. Marciniak, "Active-illumination extension to the Priest and Meier pBRDF," Opt. Express 31(21), TBD (2023).
[44] W. Barnes, H. Chang, and M. F. Spencer, "Measuring laser-speckle statistics in scaled-laboratory experiments," Appl. Opt. 62(23), 1-9 (2023).
[43] M. F. Spencer, S. Bose-Pillai, A. Fuerbach, N. Riviere, I. Toselli, M. van Iersel, and E. A. Watson, "Applications of Lasers for Sensing and Free Space Communications: introduction to the feature issue," Appl. Opt. 62(23), ALS1-ALS4 (2023).
[42] D. J. Burrell, M. F. Spencer, M. K. Beason, and R. G. Driggers, "Active-tracking scaling laws using the noise-equivalent angle due to speckle," J. Opt. Soc. Am. A 40(5), 904-913 (2023).
[41] S. A. Owens, M. F. Spencer, and G. P. Perram, "Spectral broadening effects on pulsed-source digital holography," IEEE J. Quantum Electron. 59(4), 1-9 (2023).
[40] M. Kalensky, M. R. Kemnetz, and M. F. Spencer, "Effects of Shock Waves on Shack–Hartmann Wavefront Sensor Data," AIAAJ 61(6), 2356-2368 (2023).
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- Editor's Pick

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[3] M. F. Spencer and S. J. Cusumano, "Impact of branch points in adaptive optics compensation of thermal blooming and turbulence," Proc. SPIE 8165, 816503 (2011).
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First-Author Conference Presentations

[30] M. F. Spencer, A. D. Greenwood, & N. J. Morley, "High-Energy Laser (HEL) Beam Control," Proc. Optica LTh1A.2 (2022).
- Invited

[29] M. F. Spencer and T. J. Brennan, "Deep-Turbulence Phase Compensation Using Tiled Arrays," Proc. Optica LsW4C.2 (2022).
- Invited

[28] M. F. Spencer, "Updated Directed Energy Roadmap for the Indo-Pacific Area of Responsibility," Proc. DEPS (2022).
[27] M. F. Spencer, "Directed Energy Basics: Tutorial," Proc. MSS 268 (2022).
- Invited

[26] M. F. Spencer, "Directed Energy Roadmap for the Indo-Pacific Area of Responsibility," Proc. DEPS (2021).
[25] M. F. Spencer, "Overview of the Deep Turbulence Problem and Emerging Testbeds," Proc. DEPS (2021).
[24] M. F. Spencer and C. J. Pellizzari, "Emerging solutions to the deep-turbulence problem using digital holography and deep learning," Proc. DEPS (2021).
[23] M. F. Spencer and C. J. Pellizzari, "Imaging through deep turbulence using digital holography experiments," Proc. IS&T (2021).
[22] M. F. Spencer, "Wave-optics investigation of turbulence thermal blooming interaction," Proc. DEPS (2020).
[21] M. F. Spencer, "Overview of the deep-turbulence problem for beam-control system design," Proc. DEPS (2020).
[20] M. F. Spencer, C. J. Pellizzari, and C. A. Bouman, "Imaging through deep turbulence and emerging solutions," Proc. IS&T (2020).

- Invited

[19] M. F. Spencer, "Integrating digital-holographic detection into a laser weapon system: an update," Proc. DEPS (2019).
[18] M. F. Spencer, "Impacts of turbulence thermal blooming interaction," Proc. SPIE 1113507 (2019).
[17] M. F. Spencer, C. J. Pellizzari, and D. E. Thornton, "Collaborative research in deep turbulence," Proc. Optica (2019).

- Invited

[16] M. F. Spencer, "Integrating digital-holographic detection into a laser weapon system," Proc. MSS A3B05 (2019).

- Invited

[15] M. F. Spencer and D. K. Marker, "An In-Depth Overview of Phased Array Research at AFRL," Proc. DEPS (2018).
[14] M. F. Spencer and T. J. Brennan, "Phase Compensation in the Presence of BIL-HEL Wavelength Differences," Proc. DEPS (2018).

- Invited

[13] M. F. Spencer, T. J. Brennan, and D. K. Marker, "Tiled Vs. Filled Phase Compensation: A System-Level, Deep-Turbulence Study," Proc. DEPS (2017).
[12] M. F. Spencer, N. R. Van Zandt, T. J. Brennan, D. C. Dayton, and D. K. Marker, "Comprehensive overview of a HEL-JTO sponsored wavefront sensor study," Proc. DEPS (2017).
[11] M. F. Spencer, T. J. Brennan, R. A. Raynor, and D. K. Marker, "Compensation in the Presence of Deep Turbulence Using Tiled-Aperture Architectures," Proc. DEPS (2016).
[10] M. F. Spencer, D. K. Marker, I. J. Atencio, and R. A. Hamil, "Linear Systems in Optics: A DE-inspired short course at AFRL," Proc. DEPS (2016).
[9] M. F. Spencer, T. A. Rhoadarmer, A. L. Tuffli, D. K. Marker, "Deep-Turbulence Simulation in a Scaled-Laboratory Environment Using Five Phase-Only Spatial Light Modulators," Proc. DEPS (2016).
[8] M. F. Spencer, I. V. Dragulin, D. S. Cargill, and M. J. Steinbock, "Digital holography wave-front sensing in the presence of strong atmospheric turbulence and thermal blooming," Proc. DEPS (2015).
[7] M. F. Spencer and M. W. Hyde, "The Scattering of Partially Coherent Electromagnetic Beam Illumination from a Statistically Rough Perfectly Reflecting Surface," Proc. DEPS (2014).
[6] M. F. Spencer, "Bachelors to PhD: An Education Stimulated by Research in Directed Energy," Proc. DEPS (2014)
[5] M. F. Spencer, M. W. Hyde, and S. J Cusumano, "Rough Surface Scattering as Applied to Laser Target Interaction of a Multi-Fiber Laser Source," Proc. DEPS (2011).
[4] M. F. Spencer and S. J. Cusumano, "Branch Point Mitigation of Thermal Blooming Phase Compensation Instability," Proc. DEPS (2011).
[3] M. F. Spencer, S. J. Cusumano, J. D. Schmidt, and S. T. Fiorino, "Impact of Temporal Resolution on Thermal Blooming Phase Compensation Instability," Proc. DEPS (2010).
[2] M. F. Spencer, S. J. Cusumano, J. D. Schmidt, and S. T. Fiorino, "Adaptive Optics Mitigation of Thermal Blooming Effects [Dist. C]," Proc. DEPS (2009).
[1] M. F. Spencer, S. M. Massey, and T. H. Russell, "Stimulated Brillouin Scattering Phase Conjugation in Optical Fibers," Proc. DEPS (2007).

<u>News Article</u>

M. F. Spencer, M. W. Hyde IV, "Rough surface scattering for active-illumination systems," SPIE Newsroom (2013).

Technical Report

M. F. Spencer, "Section 3.2.4.1: Wavefront Sensing & Control," in Beam Control Technology Assessment (BCTA) Report [Dist. D], Robert J. Pawlak, Amanda B. Clark, & Arthur G. Hassall, Eds., JDETO, Albuquerque, NM (2019).

PhD Dissertation

M. F. Spencer, "The Scattering of Partially Coherent Electromagnetic Beam Illumination from Statistically Rough Surfaces," PhD Dissertation, Air Force Institute of Technology, ADA603227 (2014).

MS Thesis

M. F. Spencer, "Branch Point Mitigation of Thermal Blooming Phase Compensation Instability," MS Thesis, Air Force Institute of Technology, ADA538538 (2011).

Undergraduate Honors Thesis

M. F. Spencer, "Stimulated Brillouin Scattering (SBS) Threshold in Optical Fibers," Undergraduate Honors Thesis, University of Redlands (2008).

INVITED TALKS

HEL Perspectives from a Recent Government Leader and Current Academic Researcher 2026

- National Intelligence University, Joint Staff Disruptive Technology Course
- James C. Wyant College of Optical Sciences, Industrial Affiliates
- University of Arizona, Arizona Photonics Days

HEL Perspectives from a Recent Government Leader and Current Academic Researcher 2025

- James C. Wyant College of Optical Sciences, Seminar
- University of Arizona, Active Imaging Summit

Deep-Turbulence Imaging, Sensing, and Adaptive Optics 2025

- University of Arizona, Seminar
- University of Dayton, Seminar

DoD Directed Energy Roadmap and JDETO Investments Overview 2025

- Optica Online Meeting on Defense & Security
- National Defense University Visit
- JHU APL Visit
- DARPA Technology Development Working Group Winter Meeting
- Iron Beam Kickoff Meeting

Australian-U.S. Directed Energy Program (AUSDEP) 2024

- JDETO Technical Review

Joint Directed Energy Transition Office (JDETO) Overview 2024

- University of Central Florida Industrial Affiliates Day
- AFOSR Extreme Light Workshop
- FYEY S&T, Tech Panel 9 Annual Offsite

Joint Directed Energy Transition Office (JDETO) Overview 2023

- JDETO Annual Review

Deep-Turbulence compensation and imaging *2023*

- U of Arizona, Wyant College of Optical Sciences, Colloquium

Digital Holography Requirements and State of the Art 2023

- JDETO Target Tracking Summit

USINDOPACOM Theater Threat Brief 2023

- Naval Surface Warfare Center, Dahlgren Division

Updated Directed Energy Roadmap for the Indo-Pacific Area of Responsibility 2022

- LLNL Directed Energy Meeting
- AFRL/RD CTC Townhall
- AFIT Department of Engineering Physics Seminar

Directed Energy Roadmap for the Indo-Pacific Area of Responsibility 2021

- 53rd Test & Evaluation Group (TEG) visit to HQ USINDOPACOM
- AFRL/RDLA Branch Meeting
- AFRL/RDLT Branch Meeting

Overview of the Deep Turbulence Problem and Emerging Testbeds 2021

- JDETO Target Tracking Summit
- OUSD(R&E), Directed Energy
- Air Force Weather Enterprise (AFWE) Directed Energy R&D Workshop

Real-Time Wavefront Sensing for ISR and DE Systems 2020

- AFRL CRDF S&T Final Review

System Engineering Plan for Active Track Demonstration 2020

- JDETO Inter-TAWG Meeting

New AF TILL Requirements 2020

- JDETO Illuminator Workshop

Imaging through Deep Turbulence and Emerging Solutions 2019

- AFIT Department of Engineering Physics Seminar
- U of Notre Dame Physics Department Seminar

Beam Control Laboratory Overview 2019

- AFRL/RD Aero Effects and Deep Turbulence Workshop

Deep Turbulence Refresher 2019

- AFRL/RD Aero Effects and Deep Turbulence Workshop

Real-Time Wavefront Sensing for ISR & DE Systems 2019

- AFRL CRDF S&T Review

Material Requirements for ARFL/RDLTS 2019

- AFRL/RX Chief Scientist visit to AFRL/RD

Collaborative Research in Beam Control 2019

- Japan's visit to AFRL/RD

AP TAWG – Air Force Overview 2019

- JDETO Annual Review

WFS Study 2019

- JDETO Annual Review

Scalable Laser Weapon System using Digital Holography 2019

- USAF Academy Physics Department Seminar

Collaborative Research in Beam Control 2019

- AFRL/RD Technical Interchange Meeting

Deep Turbulence Impacts, Sensing, and Mitigation 2018

- US Air Force Scientific Advisory Board's 2019 S&T Review of AFRL/RD

Real-Time Wavefront Sensing for ISR & DE Systems 2018

- AFRL CRDF S&T Review

Scalable, High-Fill-Factor Tiled Array 2018

- AFIT Department of Engineering Physics Seminar

Real-Time Wavefront Sensing for ISR & DE Systems 2018

- AFRL CRDF S&T Review

Overview of the Deep-Turbulence Problem for Laser Systems 2018

- AFRL/RD Distributed Volume Turbulence Workshop

An In-Depth Overview of Phased Array Research at AFRL 2018

- AFIT Fiber Laser Workshop

Overview of the Deep-Turbulence Problem for Laser Systems 2018

- AFRL/RD Distributed Volume Turbulence Workshop

Beam Projection and Compensation in the Presence of Deep Turbulence 2018

- AFOSR Atmospheric Workshop

AP TAWG – Air Force Overview 2018

- JDETO Annual Review

Compensation in the Presence of Deep Turbulence using Tiled-Aperture Architectures 2018

- Korea's visit to AFRL/RD

Deep Turbulence Research at AFRL/RDL 2017

- AFRL/RD Distributed Volume Turbulence Workshop

Atmospheric Characterization Efforts at AFRL/RDL 2017

- AFRL/RD Distributed Volume Turbulence Workshop

Model-Based Iterative Reconstruction 2017

- AFOSR Chief Scientist visit to AFRL/RD

Compensation in the Presence of Deep Turbulence using Tiled-Aperture Architectures 2017

- AFIT Department of Engineering Physics Seminar

AP TAWG – Air Force Overview 2017

- JDETO Annual Review

Beam Projection and Compensation 2017

- US Air Force Scientific Advisory Board's 2017 S&T Review of AFRL/RD

Optical & Deep-Turbulence Beam Control 2016

- US Air Force Scientific Advisory Board's 2016 Quicklook at AFRL/RD

AP TAWG – Air Force Overview 2016

- JDETO Annual Review

WORKSHOPS HOSTED

Directed Energy Annual Program Objective Memorandum Planning (Virtual) Meeting 2025

- Over 50 total participants from academia, industry, and government; 3-day workshop to plan directed energy investments across the DoD

JDETO Technical Review at the DEPS Systems Symposium 2024

- 3-day workshop to review the technical accomplishments of the JDETO

JDETO Technical Review at the DEPS Annual S&T Symposium 2024
- 3-day workshop to review the technical accomplishments of the JDETO

Directed Energy Annual Program Objective Memorandum Planning Meeting 2024
- Over 50 total participants from academia, industry, and government; 3-day workshop to plan directed energy investments across the DoD

Directed Energy Annual Program Objective Memorandum Planning Meeting 2023
- Over 50 total participants from academia, industry, and government; 3-day workshop to plan directed energy investments across the DoD

JDETO Annual Review 2023
- Over 175 total participants from academia, industry, and government; 3.5-day workshop to review the technical accomplishments of the JDETO

HQ USINDOPACOM, AUKUS Advanced Capabilities Principals Meeting at the POST Conference 2022
- Brought together the Under Secretary of Defense for Research & Engineering and equivalents from Australia and the United Kingdom in support of AUKUS Pillar II

HQ USINDOPACOM, AUKUS TTX at the POST Conference 2022
- 25+ participants, including AUKUS senior technology leaders & USINDOPACOM operational experts; 2-day workshop focused on the China Challenge

JDETO, AP TAWG Annual (Virtual) Offsite 2020
- Over 100 total participants from academia, industry, and government; 2-day workshop focused on the state-of-the art in atmospheric propagation in support of tri-service efforts

AFRL/RD, Aero-Effects & Deep-Turbulence Workshop 2019
- Over 150 total participants from academia, industry, and government; 3-day workshop focused on the state-of-the art in aero effects and deep turbulence

AFRL/RD, Distributed-Volume Turbulence Workshop II 2018
- Over 50 total participants from academia, industry, and government; 1-day workshop focused on the state-of-the art in deep turbulence

AFRL/RD, Distributed-Volume Turbulence Workshop I 2017
- Over 25 total participants from academia, industry, and government; 1-day workshop focused on the state-of-the art in deep turbulence

JDETO, AP TAWG Annual Offsite 2016
- Over 25 total participants from academia, industry, and government; 2-day workshop focused on the state-of-the art in atmospheric propagation in support of tri-service efforts

PROJECTS LED

Leadership Roles

Contracting Officer's Technical Representative (COTR)
Operational Manager (OM)
Principal Investigator (PI)
Technical Advisor (TA)
Technical Point of Contact (TPoC)

Types of Projects
Broad Agency Announcement (BAA)
Cooperative Research & Development Agreement (CRADA)
Commander R&D Fund (CRDF)
Coalition Warfare Program (CWP)
Deployment
Joint Capability Technology Demonstration (JCTD)
Service & Agency (S&A)
Small Business Innovation Research (SBIR)
SBIR Commercial Readiness Program (CRP)
Small Business Technology Transfer (STTR)

Government Associates
Sandia National Laboratories
AF Life Cycle Management Center, Architectures (AFLCMC/XA)
AFRL, Space Vehicles Directorate (AFRL/RV)
AFRL, Sensors Directorate (AFRL/RY)
AFRL, Strategic Development Planning & Experimentation (SDPE)
Army Space & Missile Defense Command (SMDC)
Joint Directed Energy Transition Office (JDETO)
Missile Defense Agency (MDA)
Naval Research Laboratory (NRL)
Pacific Air Forces, Futures Division (PACAF/A8)

Industry Associates
AdValue Photonics
Alphacore
Applied Technology Associates (ATA)
Booze Allen Hamilton (BAH)
Epirus
Exciting Technology
Guidestar Optical Systems
High Performance Imaging
IFOS
Lockheed Martin Coherent Technologies (LMCT)
MZA Associates Corporation
NP Photonics
Nutronics
Optonicus
Tau Technologies
the Optical Sciences Company (tOSC)
TimeLike Systems

Academic Associates
Air Force Institute of Technology (AFIT)
Montana State University (MSU)
Naval Postgraduate School (NPS)
Naval Research Laboratory (NRL)
New Mexico State University (NMSU)
Purdue University (Purdue)
University of California Los Angeles (UCLA)
University of Dayton Research Institute (UDRI)
University of Miami (U of Miami)
University of Rochester (U of Rochester)
U.S. Air Force Academy (USAFA)

Projects Led
PI, "Multi-aperture laser transmitters for atmospheric turbulence mitigation," LDRD, $100K
Oct 2025 – Sep 2026
- Worked with Sandia National Laboratories to anchor computational wave-optics predictions to experimental observations

OM, "PACAF C-sUAS Roadmap," Deployment, $4M June 2022 – Apr 2023
- Worked with PACAF/A8, AFLCMC/XA, SDPE, & AFRL/RD to deploy a commercially available high-power microwave system from Epirus

OM, "Interoperable Optical Transport," CWP with Germany $3M May 2022 – Apr 2023
- Worked with NRL to operationalize laser-based free space optical communications

OM, "Sounder Receiver (SORCER)-Enabled Ionospheric Modeling," JCTD, $9M
Oct 2021 – Apr 2023
- Worked with AFRL/RV to operationalize ionospheric measurements for over the horizon radar

OM, "Multi-Domain Agile Navigation and Timing Network Automation (MANNA)," JCTD, $12M Oct 2021 – Apr 2023
- Worked with AFRL/RV on operationalizing laser-based free space optical communications

TA, "Partially Coherent Lasers," AFRL Early Career Award, $75K Jun 2021 – Apr 2023
- Working with AFIT and the U of Miami to develop and experimentally demonstrate novel pulsed lasers

TA, "Optical-field and Imaging Sensor for Reflective Imaging with Coherent Illumination," Edison Grant, $75K Jun 2021 – Apr 2023
- Worked with USAFA to experimentally demonstrate novel computational imaging techniques using direct detection

OM, "Solid State High Power Microwave (HPM) Cannon," CWP with Singapore, $3M,
May 2021 – Apr 2023
- Worked with AFRL/RD, Army Research Laboratory, Sandia National laboratory, and Singapore to develop solid-state high power microwave sources

TPoC, “Integrating AI and Advance Algorithmic Methods to Achieve Real-Time Coherent Optical Wavefront Sensing through Atmospheric Turbulence,” University Cooperative Grant, $270K Oct 2020 – Jun 2021

- Worked with Purdue to enhance a patented approach to imaging through deep turbulence using digital holography

TPoC, “Vibration Imaging for the Characterization of Extended, Non-Cooperative Targets (VICENT),” AF STTR Phase II, $750K Oct 2020 – Jun 2021

- Worked with Exciting Technology and UD to develop vibration imaging using digital holography

TPoC, “3-D Tracking and Aimpoint Maintenance (3-D TrAM),” AF STTR Phase II, $750K Oct 2020 – Jun 2021

- Worked with MZA and U of Rochester to develop 3D imaging using digital holography

TPoC, “High-Power Adaptive Directed Energy System, Enhancements and Power Scaling (HADES-EPS),” AF SBIR Phase III, CLIN 1, $2.1M Sep 2019 – Jun 2021

- Worked with Nutronics to design, build, and test a novel tiled-array architecture using digital holography

TPoC, “Volume Digital Holographic Wavefront Sensor,” AF STTR Phase II, $750K Sep 2019 – Jun 2021

- Worked with Nutronics and MSU to develop volumetric wavefront sensing using digital holography

TPoC, “Next Generation Laser Weapon System Technologies,” AF CRADA, $4M Aug 2019 – Jun 2022

- Worked with LMCT to design, build, and test digital-holography technology for multiple applications

TPoC, “Low Cost Inertial Rate Sensors with Long Term Stability,” AF SBIR Phase II CRP, $1.3M Jul 2019 – Oct 2020

- Worked with IFOS to commercialize a fiber-optic gyro with increased stability for use with optical inertial reference units

TPoC, “Fast-Framing SWIR Cameras for digital-Holographic Detection,” AF SBIR Phase I, $150K Jun 2019 – Jan 2020

- Worked with Alphacore to design a digital-holography camera

TPoC, “Fast Infrared Camera for Digital Holography,” AF SBIR Phase I, $150K Jun 2019 – Jan 2020

- Worked with Guidestar Optical Systems to test a potential digital-holography camera

TPoC, “Eye-Safe Fiber Laser Illuminator for Coherent Detection,” AF SBIR Phase I, $150K Jun 2019 – Jan 2020

- Worked with NP Photonics to design a digital-holography illuminator laser with transform-limited pulses

TPoC, “An all-fiber high-energy pulsed illuminator for coherent detection,” AF SBIR Phase I, $150K Jun 2019 – Jan 2020

- Worked with AdValue Photonics to design a digital-holography illuminator laser with transform-limited pulses

TPoC, "Vibration Imaging for the Characterization of Extended, Non-Cooperative Targets (VINCENT)," AF STTR Phase I, $150K Jun 2019 – Jan 2020

- Worked with Exciting Technology and UDRI to develop vibration imaging using digital holography

TPoC, "Vibration Imaging Using Dual Wavelength Digital Holography," AF STTR Phase I, $150K Jun 2019 – Jan 2020

- Worked with Guidestar Optical Systems and UCLA to develop vibration imaging using digital holography

TPoC, "Vibration Imaging for the Characterization of Extended, Non-Cooperative Targets," AF STTR Phase I, $150K Jun 2019 – Jan 2020

- Worked with Tau Technologies and NMSU to develop vibration imaging using digital holography

TPoC, "3-D Tracking and Aimpoint Maintenance (3-D TrAM)," AF STTR Phase I, $150K Jun 2019 – Jan 2020

- Worked with MZA and the U of Rochester to develop 3D imaging using digital holography

TPoC, "3D Imaging for Tracking and Aim-point Maintenance in the Presence of Target-pose Changes," AF STTR Phase I, $150K Jun 2019 – Jan 2020

- Worked with Tau Technologies and NMSU to develop 3D imaging using digital holography

COTR, "Beacon-Less Atmospheric Sensing Tiled Array and Receiver (BLASTAR)," JDETO BAA, $1.25M Apr 2019 – Sep 2021

- Worked with LMCT to design, build, and test a novel tiled-array architecture using digital holography

PI, "Scalable, High-Fill-Factor Tiled Array," JDETO S&A, $1.25M Jan 2019 – Jun 2021

- Worked with a NRL, Army SMDC, USAFA, and AFIT to design, build, and test a novel tiled-array architecture using digital holography

TPoC, "Volume Digital Holographic Wavefront Sensor," AF STTR Phase I, $150K Sep 2018 – Feb 2019

- Worked with Nutronics and MSU to develop volumetric wavefront sensing

TPoC, "High Performance Computing for Imaging through Atmospheric Turbulence," AF STTR Phase I, $150K Sep 2018 – Feb 2019

- Worked with High Performance Imaging and Purdue to develop volumetric wavefront sensing

TPoC, "Volumetric Wavefront Sensing for the Characterization of Distributed-Volume Aberrations," AF STTR Phase I, $150K Sep 2018 – Feb 2019

- Worked with Guidestar Optical Systems and UCLA to develop volumetric wavefront sensing

TPoC, "Phased Array Steering Transmitter and Holographic Receiver (PHASTAHR)," AF BAA, $6.1M Dec 2017 – Sep 2021

- Worked with LMCT to design, build, and test a digital-holography imaging system

TPoC, “Holographic Imaging to Support Air-to-Air, High-Bandwidth, Image-Based, Active Tracking,” AF SBIR Phase II, $700K Oct 2017 – Oct 2019

- Worked with Guidestar Optical Systems to design, build, and test a tracking system using digital holography

COTR, “Digital Holography Deep Turbulence Adaptive Optics (DH Deep TAO),” JDETO BAA, $3M Sep 2017 – Sept 2021

- Worked with LMCT to design, build, and test an adaptive optics system using digital holography

TPoC, “Leading Edge Optical Phased Array Research and Development (LEOPARD),” AF BAA, $3.7M Sep 2017 – Jun 2022

- Worked with ATA to execute in-house research efforts

PI, “Real-Time Wavefront Sensing for ISR and DE Systems,” CRDF, $3.1M Sep 2017 – Sep 2020

- Worked with the AFRL/RY, AFIT, and U of Rochester to design, build, and test a digital-holography imaging system

TPoC, “High Energy Laser Requirements Analysis and Engineering (HELRAE),” MDA SBIR Phase II, $1M Aug 2017 – July 2022

- Worked with Nutronics to develop an easy-to-use, high-fidelity modeling and simulation tool

TPoC, “GPU-Based Computational Platform for Performance Evaluation of HEL Directed Energy Weapon Technology,” MDA SBIR Phase II, $1M Aug 2017 – Apr 2020

- Worked with Optonicus to develop an easy-to-use, high-fidelity modeling and simulation tool

Co-PI, “Beaconless woofer-tweeter compensation using image sharpening,” JDETO S&A, $1M Jun 2017 – Mar 2020

- Worked with the NRL to design an adaptive optics system using digital holography

TPoC, “Reflective Atmospheric Turbulence Simulator (RATS),” AF SBIR Phase III, $1.9M Dec 2016 – Mar 2021

- Worked with Nutronics to develop an atmospheric and aero-optic turbulence simulator

PI, “Wavefront Sensor Study,” JDETO S&A, $800K Jan 2016 – Dec 2018

- Worked with AFIT to document the art with respect to deep turbulence and made path-forward recommendations

Principal Investigator, “Coherent Beam Combination from a Spatially Distributed Fiber Laser System Using Digital Holography, JDETO,” $800K Jan 2015 – Dec 2016

- Worked with the NPS to develop an atmospheric turbulence simulator and adaptive optics system

TPoC, “High Energy Laser Requirements Analysis and Engineering (HELRAE),” MDA SBIR Phase I, $200K Apr 2016 – Oct 2016

- Worked with Nutronics to develop an easy-to-use, high-fidelity modeling and simulation tool

TPoC, “GPU-Based Computational Platform for Performance Evaluation of HEL Directed Energy Weapon Technology,” MDA SBIR Phase I, $200K Apr 2016 – Oct 2016

- Worked with Optonicus to develop an easy-to-use, high-fidelity modeling and simulation tool

TPoC, "Robust Multi-Fidelity Modeling for High Energy Laser Systems," MDA SBIR Phase I, $200K Apr 2016 – Oct 2016

- Worked with TimeLike Systems to develop an easy-to-use, high-fidelity modeling and simulation tool

TPoC, "Transition of the Next Generation High Power Phased Array Transceivers," AF STTR Phase II, $1.2M Sep 2014 – Nov 2017

- Worked with tOSC and the AFIT to develop target-based phase sensing for laser phased arrays