

YUZURU TAKASHIMA Ph.D.

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Web: <http://www.optics.arizona.edu/research/faculty/profile/yuzuru-takashima>

EDUCATION

Ph.D., Electrical Engineering, Stanford University, Stanford, CA 04/2007

- Concentrations: Physical and geometrical optics, Aberration theories, Lens and optical system designs.
- Dissertation: Optical system designs for page-based and bit-based holographic data storage systems.
- Among the top 10 students in Ph.D. qualification exam.

M.S., Electrical Engineering, Stanford University, Stanford, CA. 04/2003

B.S., Physics, Kyoto University, Kyoto, Japan. 03/1990

MAJOR Research FIELDS

Lidar:

Laser beam steering device, MEMS-LiDAR, Automotive LiDAR, Single-chip LiDARs,

Display:

Near-to-eye display, Multi-perspective 3D display, On-chip 3D display

Information optics:

Optical data storage, Holographic data storage, Micro and nano free-form optics, Optical interconnect,

Optical Engineering:

Lens and optical design, Space optics, Lithography optics, Camera optics, Interferometry, Digital Micromirror Device, Holography, Computer Generated holograms, X-ray imaging device

EMPLOYMENT

Associate Professor, The University of Arizona, Tucson, AZ 2011-Current

Visiting Professor, Utsunomiya University, Utsunomiya, Japan 11/2014-03/2015

Engineering Research Associate, Stanford University, Stanford, CA 2010

Postdoctoral Scholar, Stanford University, Stanford, CA 2007-2010

Optical Engineer, Solyndra Inc., Santa Clara CeA 2006

Research Assistant, Stanford University, Stanford, CA 2000-2007

Research Specialist, Toshiba Manufacturing Engineering Research Center, Yokohama, JAPAN 1990-2000

AWARDS

Certificate of Achievement, The Center for Biomedical Imaging at Stanford April 22, 2010

SERVICE / OUTREACH

Professional Societies

- Optical Society of America (OSA): **Senior Member**, 2017-
- SPIE: **Senior Member**, 2017-
- Optical Design Group Japan (Japanese Society of Applied Physics): Member

National / International Outreach

- NSF Center for Integrated Access Network, Pre-college Director 2013
- Program Manager: 2012, 2014, 2016, 2017 Optical Design and Measurement Tokyo Short Course Program in Japan

2012-Current

University Committee: N/A

Departmental Committee:

- College of Engineering Advisory Committee 2018-Current

College Committee

- Member: Undergraduate Curriculum Committee 2017-20,2014
- Member: Academic Program Review Committee 2017, 2013
- Member: Graduation Admission Committee 2016
- Member: Prelim Committee 2016
- Chair: Scholarship Committee 2015
- Member: Colloquium Committee 2013
- Member: Prelim Committee 2012
- Member: Academic Program Review Committee 2017, 2012

PROFESSIONAL AFFILIATIONS: Senior Member of SPIE, Senior Member OSA, Member of Optical Design Group/JSAP

1. **General Co-Chair**, Optical Data Storage (ODS) 2012, 2017-Current
2. Member of Program Committee, Optical Memories for Big Data Storage, The International Symposium on Optoelectronic Technology and Application (OTA 2016) 2016-Current.
3. Member of Program Committee, Optical Data Storage (ODS) 2014-Current.
4. Member of Program Committee, Optics-photonics Design and Fabrication (ODF) Japan 2014-Current.
5. **General Co-Chair**, OSA Topical Meeting on Optical Data Storage 2012 (Tucson AZ, USA).
6. Session Chair, OSA Topical Meeting on Optical Data Storage 2011 (Kauai HI, USA).
7. Member of Program Committee, OSA Topical Meeting on Optical Data Storage 2011.
8. Member of Program Committee, Current Development in Lens Design and Optical Engineering, SPIE Optics and Photonics 2010-Current.
9. Early Career Observer in Planning Committee Meeting for Optomechanics; Optical Design; Optical Manufacturing and Testing; Advanced Metrology; Optical Systems Engineering, SPIE Optics and Photonics 2009.
10. Member of Committee, Research Group on Next Generation Image Media in Optoelectronic Industry and Technology Development Association Japan (1999-2000)
11. Reviewer, Optical Society of America: Applied Optics, Journal of Optical Society of America and Optics Express.
12. Stanford Freshman and Undergraduate Advising as a Pre-major Advisor (2009-2011)

Refereed Journals:**Submitted**

1. K. Sanaka, Y. Takashima, "Experimental demonstration of a novel scheme for storing and retrieving arbitrary polarization states in photorefractive medium", Submitted to Journal Annalen der Physik (Sep. 2019).
2. Brandon Hellman and Yuzuru Takashima, "Wide-angle MEMS-based imaging lidar by decoupled scan axes", submitted for Applied Optics (Sep. 2019).
3. Joshua Rodriguez, Braden Smith, Brandon Hellman, Heejoo Choi, Guanghao Chen, Dae Wook Kim, Youngsik Kim, and Yuzuru Takashima, "Multi-order laser beam steering with digital micro mirror device for high sampling rate lidar applications", Submitted for Optics Express, (Sep. 2019).

In Revision**Accepted****Published**

4. Brandon Hellman and Yuzuru Takashima, "Angular and spatial light modulation by single digital micromirror device for multi-image output and nearly-doubled étendue," *Opt. Express* 27, 21477-21496 (2019).
5. T. Nakamura and Y. Takashima, "Design of discretely depth-varying holographic grating for image guide based see-through and near-to-eye displays," *Opt. Express* 26, 26520-26533 (2018). <https://doi.org/10.1364/OE.26.026520>
6. A. Özdemir, N. Yılmaz, S. Alboon, Y. Takashima, and H. Kurt, "Analysis of the focusing crosstalk effects of broadband all-dielectric planar metasurface microlens arrays for ultra-compact optical device applications," *OSA Continuum* 1, 506-520 (2018). <https://doi.org/10.1364/OSAC.1.000506>
7. Kazuyoshi Yamazaki and Yuzuru Takashima, "Time Differential Phase Detection Method for Robust Industrial Non-destructive Inspections" *Japanese Journal of Applied Physics* (2018) <https://doi.org/10.7567/JJAP.57.09SB04>
8. Sungwon Choi, Yuzuru Takashima, and Sung-Wook Min, "Improvement of fill factor in pinhole-type integral imaging display using a retroreflector," *Opt. Express* 25, 33078-33087 (2017).
9. Y. Nakamura, T. Hoshizawa, and Y. Takashima, "Coherent Scattering Noise Reduction Method with Wavelength Diversity Detection for Holographic Data Storage System", *Jpn. J. Appl. Phys.* 56 09NA08 (2017), <http://iopscience.iop.org/article/10.7567/JJAP.56.09NA08/meta>
10. Chris Summitt, Sunglin Wang, Soha Namnabat, Lee Johnson, Tom Milster, and Yuzuru Takashima, "Fast fabrication of polymer out-of-plane optical coupler by gray-scale lithography," *Opt. Express* 25, 17960-17970 (2017) <https://doi.org/10.1364/OE.25.017960>
11. Braden Smith, Brandon Hellman, Adley Gin, Alonzo Espinoza and Yuzuru Takashima, "Single Chip Lidar with Discrete Beam Steering by Digital Micromirror Device", *Optics Express*, Vol. 25, Issue 13, pp. 14732-14745 (2017) <https://doi.org/10.1364/OE.25.014732>
12. Aytekin Ozdemir, Zeki Hayran, Yuzuru Takashima, and Hamza Kurt, "Polarization independent high transmission large numerical aperture laser beam focusing and deflection by dielectric Huygens' metasurfaces", *Optics Communications*, Volume 401, 15 October 2017, Pages 46–53 (<https://doi.org/10.1016/j.optcom.2017.05.031>)
13. J. Wilde, J. Goodman, Y. Eldar, and Y. Takashima, "Coherent super resolution imaging via grating-based illumination" *Appl. Opt.* Vol 56, Issue 1, pp. A79-A88 (<https://doi.org/10.1364/AO.56.000A79>) (2017).
14. B. Miller and Y. Takashima, "Cavity-enhanced eigenmode and angular hybrid multiplexing in holographic data storage systems," *Opt. Express* 24 (26), 29465-29476 (2016). <https://doi.org/10.1364/OE.24.029465>
15. Toshiki Ishii, Ken-ichi Shimada, Taku Hoshizawa and Yuzuru Takashima, "Modeling and analysis of vibration effects on signal quality for angular multiplexed holographic data storage" ", *Jpn. J. Appl. Phys.* 55, Number 9S, <http://iopscience.iop.org/issue/1347-4065/55/9S> Special Issue on Optical Memories (2016).
16. B. Miller and Y. Takashima, "Cavity techniques for holographic data storage recording," *Opt. Express* 24, 6300-6317 (2016).
17. Toshiki Ishii, Ken-ichi Shimada, Taku Hoshizawa, and Yuzuru Takashima, "Analysis of vibration effects on holographic data storage system", *Jpn. J. Appl. Phys.* 54 09MA04 doi:10.7567/JJAP.54.09MA04 Special Issue on Optical Memories (2015).
18. Ken-ichi Shimada, Toshiki Ishii, Taku Hoshizawa, and Yuzuru Takashima, " New optical modeling and optical compensation for mechanical instabilities on holographic data storage system using time averaged holography", *Jpn. J. Appl. Phys.* 54 09MA01 doi:10.7567/JJAP.54.09MA01 Special Issue on Optical Memories (2015).
19. Ming Li, Milorad Cvijetic, Yuzuru Takashima, Xiaole Sun, and Zhongyuan Yu, "Evaluation of channel capacities of OAM-based FSO link with real-time wavefront correction by adaptive optics" *Optics Express*, Vol. 22, Issue 25, pp. 31337-31346 (2014).
20. Y. Takashima. "Optical design in high density and high capacity multi-layer data storage system" *Front. Optoelectron.* 7, Issue 4, pp 425-436 (2014).
21. Y. Cheng, Y. Takashima, P. Hansen, J. B. Leen, Y. Yuen, and L. Hesselink. "Resonant C-shaped Aperture Nano-tip". *Optics Express*, 19: 5077-5085 (2011).
22. X. Shi, V. Ostroverkhov, B. Lawrence, E. Boden, Z. Ren, Y. Takashima, F. Ross. "Micro-Holographic Data Storage: Materials and Systems," *Review of Laser Engineering*, 38: 349-355, (2010).

23. *Y. Takashima and L. Hesselink. "Design and tolerance of NA 0.8 objective lenses for page-based holographic data storage systems". Jap. J. Appl. Phys., 48:03A004-1, (2009).
24. *Y. Takashima and L. Hesselink. "Media tilt tolerance of bit-based and page-based holographic storage systems". Opt. Lett., 31:1513-1515, (2006).
25. *S. S. Orlov, W. Phillips, E. Bjornson, Y. Takashima, P. Sundaram, L. Hesselink, R. Okas, D. Kwan, R. Snyder. "High-transfer-rate high-capacity holographic disk data-storage system," Appl. Opt., 43:4902, (2004).

In Preparation, as of Sep 13, 2017:

26. B. Hellman, B. Smith, A. Gin, Y. Kim, G. Chen, P. Winkler and Y. Takashima "Wide Field-of-View and Mid-Range Distance Imaging LIDAR by Digital Micro-Mirror Device".
27. Guanghao Chen, Bo Miller, Yuzuru Takashima, "Crosstalk Reduction in Cavity Enhanced, Orthogonal Mode and Anuglar Hybrid Multiplexing for HDSS"

Conference Proceeding Articles

Invited Articles:

1. Y. Takashima, B. Hellman," Lidar and AR Displays, Future in Optics", *Invited* for The 56th Annual Meeting of the Japanese Society of Ophthalmological Optics (Focus 2020) in Yokohama, Japan. (<https://www.56jsoo.com/program>)
2. Y. Takashima, B. Hellman," Lidar and AR Displays by MEMS-based Angular and Spatial Light Modulation", *Invited* for 12th International Conference on Optics-photonics Design and Fabrication (ODF 2020) in Taoyuan, Taiwan.
3. T. Nakamura and Y. Takashima, "Design of discretely depth-varying holographic grating for image guide based see-through and near-to-eye displays," *Invited* for Imaging Sensing and Optical Memory (ISOM 2019).
4. Y. Takashima, B. Hellman, J. Rodriguez, C. Luo, I. B. Donnelly, T. L. Lee, X. Deng, Y. Kim, H. Choi, E. Evans, and D. Kim, "Imaging LIDARs by Digital Micromirror Device" *Specially Invited Paper* for Imaging Sensing and Optical Memory (ISOM 2019).
5. Yuzuru Takashima, Brandon Hellman, Joshua Rodriguez, Guanghao Chen, Braden Smith, Adley Gin, Alonzo Espinoza, Paul Winkler, Cameron Perl, Chuan Luo, Eunmo Kang, Youngsik Kim, Heejoo Choi, and Daewook Kim, "MEMS-based Imaging LIDAR" *Invited* for OSA E2 conference in Singapore (2018).
6. Toshiki Ishii, Kenichi Shimada, Taku Hoshizawa, Yuzuru Takashima, "Pre-Write Operation and Post Optical Compensation for Robust Holographic Data Storage System (**Invited Paper**)" International Symposium on Optical Memory (ISOM 2015).
7. Kenichi Shimada, Toshiki Ishii, Taku Hoshizawa, Yuzuru Takashima, "Modeling and measures against the effect of mechanical instabilities on holographic data storage system (**Invited Paper**)" SPIE Optics and Photonics, Optical Data Storage (ODS 2015).
8. Yuzuru Takashima, "Recent progress towards practical holographic digital data storage system (**Invited Paper**)" SPIE Optics and Photonics, Optical Data Storage (ODS 2015).

Contributed Articles:

Submitted:

9. B. Hellman, Y. Takashima," Angular and spatial light modulation by single digital micromirror device for display applications" submitted for SPIE Photonics West AR/VR/MR 2020 (AVR2020).

Accepted:

10. B. Hellman, Y. Takashima," Angular and spatial light modulation by single digital micromirror device for beam and pattern steering" Accepted for SPIE Photonics West (SPIE OPTO-PW200).

11. B. Hellman, Y. Takashima, "Angular and Spatial Light Modulation by Single Digital Micromirror Device for Multi-Image Output and Nearly-Doubled Etendue" *Frontiers in Optics + Laser Science*, 15-19 September 2019.
12. Joshua Rodriguez, Braden Smith, Brandon Hellman, Heejoo Choi, Guanghao Chen, Young-Sik Kim, Dae Wook Kim, and Yuzuru Takashima, "High-speed LIDAR by multi-order laser beam steering with digital micromirror device" *SPIE Optics and Photonics* 2019.
13. Joshua Rodriguez, Brandon Hellman, Braden Smith, Heejoo Choi, Guanghao Chen, Young-Sik Kim, Dae Wook Kim, and Yuzuru Takashima, "Multi-order Laser Beam Steering with Digital Micro Mirror Device for High-speed LIDARs" accepted for *CLEO* 2019.
14. Aman Chandra, Siddhartha Sirsi, Heejoo Choi, Andy Phan, Yuzuru Takashima, Dae Wook Kim, Christopher Walker, "Thermally formed inflatable reflectors for space telescopes" Submitted for *IEEE Aerospace Conference* 2019.
15. Yoshitaka Takekawa, Yuki Nagahama, Yuzuru Takashima and Yasuhiro Takaki, "Proposal of holographic display using MEMS-SLM and pulse modulated laser" *OSA Digital Holography* 2019.
16. K. Sanaka, M. Takeuchi, R. Moriki, R. Suzuki and Y. Takashima, "Recording arbitrary polarization states on photorefractive media", *Proc. SPIE. 10757, Optical Data Storage 2018: Industrial Optical Devices and Systems*.
17. T. Nakamura, Y. Takashima, "Physical and geometrical hybrid design of two-layer and depth-chirped holographic image guide for see-through glass type head mounted display", *Proc. SPIE. 10757, Optical Data Storage 2018: Industrial Optical Devices and Systems*.
18. Joshua Rodriguez, Eunmo Kang, Brandon Hellman, Guanghao Chen, Braden Smith, Adley Gin, Alonzo Espinoza, and Yuzuru Takashima, "Beam steering by digital micro-mirror device for multi-beam and single-chip LIDAR", *Proc. SPIE. 10757, Optical Data Storage 2018: Industrial Optical Devices and Systems*.
19. Guanghao Chen, Brandon Hellman, Joshua Rodriguez, Braden Smith, Adley Gin, and Yuzuru Takashima, "Light Recycling Techniques for Efficient Beam Steering by Digital Micromirror Device", *Proc. SPIE. 10757, Optical Data Storage 2018: Industrial Optical Devices and Systems*.
20. Brandon Hellman, Braden Smith, Guanghao Chen, Joshua Rodriguez, Adley Gin, Paul Winkler, Young-Sik Kim, and Yuzuru Takashima, "Single detector imaging lidar by digital micromirror device for large field-of-view and mid-range mapping applications", *Proc. SPIE. 10757, Optical Data Storage 2018: Industrial Optical Devices and Systems*.
21. M. Salem and Y. Takashima, "Design of Phased Array Beam Steering Device for Situation Awareness Applications", *Proc. SPIE. 10757, Optical Data Storage 2018: Industrial Optical Devices and Systems*.
22. Y. Takashima, et. al., "Single-chip LIDAR", 2018 *CLEO Tech Transfer Program, CLEO 2018*.
23. "All-dielectric metasurface lenses for focal plane arrays operating in mid-wave infrared spectrum" *Conference on Metamaterials, Metadevices, and Metasystems 2018*, part of *SPIE Nanoscience + Engineering*
24. Joshua Rodriguez, Braden Smith, Brandon Hellman, Adley Gin, Alonzo Espinoza, Yuzuru Takashima, "Multi-beam and single-chip LIDAR with discrete beam-steering by digital micromirror device", *Proc. SPIE 10526, Physics and Simulation of Optoelectronic Devices XXVI, 105260U (23 February 2018)*; doi: 10.1117/12.2287485; <https://doi.org/10.1117/12.2287485>
25. K. Yamazaki and Y. Takashima, "Environmentally Robust Phase Detection Methods for Industrial Non-destructive Inspection", Tu-J-39, *Imaging Sensing and Optical Memory (ISOM) 2017*.
26. Braden Smith, Brandon Hellman, Adley Gin, Alonzo Espinoza, Yuzuru Takashima, "MEMS-based Single Chip Lidar", *OSA Frontier in Optics*, 2017.
27. B. Hellman, E. Bosset, L. Ender, N. Jafari, P. McCann, C. Nguyen, C. Summitt, S. Wang, Y. Takashima. "3D Visualization of Optical Ray Aberration and Its Broadcasting to Smartphones by Ray Aberration Generator", *IODC-2017-IM3A.5, International Optical Design Conference 2017* (<https://www.osapublishing.org/abstract.cfm?uri=IODC-2017-IM3A.5>)

28. C. Walker, S. Smith, P. Goldsmith, S O'Dougherty, Y. Takashima, and D. Kim, "Spherical Reflectors for Space Based Telescopes", International Microwave Symposium 2017 (July 4-7 Honolulu, Hawaii), Paper TH4H-4.
29. Bo Miller, and Yuzuru Takashima, "Cavity Enhanced Image Recording for Holographic Data Storage," Optical Data Storage, Proceedings Volume 10384, Optical Data Storage 2017: From New Materials to New Systems;1038406 (2017); doi: 10.1117/12.2272613
30. Guanghao Chen, Bo Miller, and Yuzuru Takashima, "Cavity enhanced eigenmode multiplexing with spatial light modulators for volume holographic data storage" Proceedings Volume 10384, Optical Data Storage 2017: From New Materials to New Systems;1038407 (2017); doi: 10.1117/12.2276985
31. B. Hellman, B. Smith, A. Gin, Y. Kim, G. Chen, P. Winkler and Y. Takashima "Wide Field-of-View and Mid-Range Distance Imaging LIDAR by Digital Micro-Mirror Device" CLEO 2017. https://doi.org/10.1364/CLEO_SI.2017.SW4L.4
32. Y. Nakamura, T. Hoshizawa, and Y. Takashima, "Coherent Scattering Noise Reduction Method with Wavelength Diversity Detection for Holographic Data Storage System" International Symposium on Optical Data Storage We-L-01, (2016)
33. B. Hellman, E. Bosset, L. Ender, N. Jafari1, P. McCann, C. Nguyen, C. Summitt, S. Wang, Y. Takashima." 3D Visualization of Optical Ray Aberration and Its Broadcasting to Smartphones by Ray Aberration Generator", International OSA Network of Students (IONS Tucson 2016).
34. Bo Miller and Yuzuru Takashima, "Cavity Enhanced Image Recording for Holographic Data Storage", Optical Data Storage (ODS) 2016 in SPIE Optics+ Photonics 2016, paper 9959-3 (2016).
35. Y. Takashima, B. Hellman, A. Erstad, Y. Kim, J. Kim, and S. Min, "Images Transfer through Thin Image Guides by Pseudo Phase Conjugation," in Imaging and Applied Optics 2016, OSA Technical Digest (online) (Optical Society of America, 2016), paper JW4A.32.
36. Alonzo Espinoza, Garret Odom, Wenbo Gao, Milorad Cvijetic, Yuzuru Takashima, "Optical design of communication simulator for orbital angular momentum based free-space link with an adaptive optics receiver.," SPIE Optics and Photonics, Laser Communication and Propagation through the Atmosphere and Oceans IV (2015)
37. Bo Miller and Yuzuru Takashima," Enhancement of Data Rates by Single and Double Cavity Holographic Recording" SPIE Optics and Photonics, Optical Data Storage (ODS 2015)
38. Jilin Yang, Tao Ge, Chris Summitt, Sunclin Wang, Tom Milster, Yuzuru Takashima," All-polymer based fabrication process for an all-polymer flexible and parallel optical interconnect", SPIE Optics and Photonics, Nanoengineering: Fabrication, Properties, Optics, and Devices XII (2015)
39. Young-Sik Kim, Chris Summitt, Sunclin Wang, Max Yuen, Charles Qi, Lambertus Hesselink, Yuzuru Takashima." Young-Sik Kim, Chris Summitt, Sunclin Wang, Max Yuen, Charles Qi, Lambertus Hesselink, Yuzuru Takashima."Novel 3D Differential Phase Contrast Imaging System", CC3DMR (2015)
40. Tao Ge, Jilin Yang, Chris Summitt, Sunclin Wang, Lee Johnson, Melissa Zaverton, Tom Milster, Yuzuru Takashima," High contrast and metal-less alignment process for all polymer optical interconnect devices", SPIE Photonics West, MOEMS-MEMS, Advanced Fabrication Technologies for Micro/Nano Optics and Photonics VIII (2015)
41. C. Summitt, S. Wang, T. Ge, J. Yang, L. Johnson, M. Zaverton, T. Milster, Y. Takashima, "Process Optimization for a 3D Optical Coupler and Waveguide Fabrication on a Single Substrate Using Buffercoat Material" SPIE Photonics West, MOEMS-MEMS, Advanced Fabrication Technologies for Micro/Nano Optics and Photonics VIII (2015)
42. Ming Li, Yuzuru Takashima, Xiaole Sun, Zhongyuan Yu, Milorad Cvijetic,"Enhancement of channel capacity of OAM-based FSO link by correction of distorted wave-front under strong turbulence" FIO 2014.
43. T. Ge, J. Yang, Y. Takashima, "Phase contrast alignment for all polymer optical interconnect devices", OSA-FIO 2014.
44. T. Ishii, K. Shimada, T. Hoshizawa, Y. Takashima, "Efficient Write Mode Control against Vibration Effect on Holographic Data Storage System", Technical Digest of ISOM 2014, October 20, 2014, Th-PD-03.

45. K. Shimada, T. Ishii, T. Hoshizawa, Y. Takashima, "New Optical Modeling of the Effect of Mechanical Instabilities on Holographic Data Storage System using Time Average Holography", Technical Digest of ISOM 2014, October 20, 2014, Th-K-02.
46. Bo E. Miller, Yuzuru Takashima, "Formalization and experimental evaluation of cavity-enhanced holographic readout", Proc. SPIE 9201, Optical Data Storage 2014, 920104 (September 5, 2014); doi:10.1117/12.2061448.
47. Y. Takashima, J. Kim, Y. Cheng, M. Yuen, J. P. Wilde, L. Hesselink, "Design of X-ray Differential Phase Contrast Imaging System for High Energy and Wide Spectrum X-ray Applications" CLEO 2014.
48. Y. Takashima, J. Kim, Y. Cheng, M. Yuen, L. Hesselink, "Design and Analysis of an X-ray Differential Phase Contrast Imaging System with Grating-less X-ray Source and Detectors", IODC 2014.
49. M. Cvijetic, Y. Takashima, "Beyond 1 Mb/s free-space optical quantum key distribution", 16-th. IEEE Conference of on Transparent Optical Networks, Graz, July 6, 2014, paper We.D3.1.
50. Ming Li, Milorad Cvijetic, Zhongyuan Yu, "Evaluation of channel capacity of the OAM-based FSO links with a precise assessment of turbulence impact" CLEO 2014.
51. Milorad Cvijetic, Yuzuru Takashima, Beyond 1Mb/s Free-Space Optical Quantum Key Distribution via Orbital Angular Momentum and WDM-based MIMO in Turbulent Atmospheric Channels OFC 2014.
52. Sunghin Wang, Chris Summitt, Lee Johnson, Melissa Zaverton, Tom Milster, Yuzuru Takashima, "Optical characterization of CMOS compatible micro optics fabricated by mask-based and mask-less hybrid lithography", Proc. SPIE 9170, Nanoengineering: Fabrication, Properties, Optics, and Devices XI, 91700F (15 September 2014); doi: 10.1117/12.2062414.
53. Chris Summitt, Sunghin Wang, Lee Johnson, Melissa Zaverton, Tao Ge, Tom Milster, Yuzuru Takashima, "Micro-optics fabrication by mask-based and mask-less mixed lithography process towards 3D optical circuits", Proc. SPIE 8974, Advanced Fabrication Technologies for Micro/Nano Optics and Photonics VII, 89740C (March 7, 2014).
54. Sunghin Wang, Chris Summitt, Lee Johnson, Melissa Zaverton, Tom Milster, Yuzuru Takashima, "Alignment Process for Fabrication of Mirror-based Optical Via using Maskless Lithography Tool with Buffer Coat Materials", IMAPS 10th International Conference and Exhibition on Device Packaging 2014.
55. Milorad Cvijetic, Yuzuru Takashima, "Beyond 1Mb/s Free-Space Optical Quantum Key Distribution via Orbital Angular Momentum and WDM-based MIMO in Turbulent Atmospheric Channels", OFC 2014.
56. C. Summitt, S. Wang, L. Johnson, M. Zaverton, T. Milster and Y. Takashima, "Flexible micro-optics fabrication by direct laser writing toward CMOS compatible 3D optical circuit", Proc. SPIE 8613, Advanced Fabrication Technologies for Micro/Nano Optics and Photonics VI, 86130K (March 5, 2013); doi:10.1117/12.2004996
57. Y. Takashima, L. Hesselink. "Design and implementation of multi-layer and multi-bit micro holographic optical data storage employing blue lasers", SPIE Current Developments in Lens Design and Optical engineering XIII 8486 0F (2012).
58. Y. T. Cheng, L. Hesselink, R. F. Pease, J. Maldonado, Y. Takashima, C. Huynh, and L Scipioni, "Nanoscale Photoelectron Emission Using C-shaped Nanoapertures with Cesium Bromide Photocathode", The 56th International Conference on Electron, Ion, and Photon Beam Technology and Nanofabrication (2012).

2011 and Before

59. Y. Takashima, L. Hesselink. "Design and Implementation of Zoom Objectives for Multi-layer Optical Data Storage", ISOM/ODS Joint Symposium, Kauai, Hawaii (2011)
60. L. Hesselink, P. Hansen, Y. Takashima. "Fundamental Understanding of Near-field Transducers", **Keynote Presentation** in ISOM/ODS Joint Symposium, Kauai, Hawaii (2011)
61. E. P. Boden, K. P. Chan, D. V. Dyllov, E. M. Kim, P. W. Lorraine, P. J. McCloskey, M. J. Misner, A. Natarajan, V. Ostroverkhov, J. E. Pickett, X. Shi, Y. Takashima, V. H. Watkins. "Recent Progress in Micro-Holographic Storage", **Invited Paper** in ISOM/ODS Joint Symposium, Kauai, Hawaii (2011)
62. Y. Cheng, Y. Takashima, J. R. Maldonado, D. Ferranti, W. Thompson, L. Hesselink and R.F. Pease "Crisp, high aspect-ratio, C-shaped nanoapertures fabricated in evaporated aluminum using focused helium ions", The 55th International Conference on Electron, Ion, and Photon Beam Technology and Nanofabrication, Las Vegas, Nevada (2011)

63. Y. Cheng, Y. Takashima, J. R. Maldonado, L. Scipioni, D. Ferranti, P. Panetta L. Hesselink and R. F. Pease. "Sub-15 nm Photo-electron Source Using a Nano-aperture Integrated with a Nano-antenna", CLEO, Baltimore, MD (2011).
64. Y. Takashima, L. Hesselink, J. Liu, L. Yang. "Novel optical architecture for high capacity and high data transfer rate holographic data Storage", CLEO, Baltimore, MD (2011).
65. J. P. Wilde, J. W. Goodman, Y. C. Eldar, Y. Takashima. "Grating-Enhanced Coherent Imaging", The 9th International Conference on Sampling Theory and Applications (2011)
66. Y. Cheng, Y. Takashima, Y. Yuen, P. Hansen, and L. Hesselink. "A $\lambda/50$ near-field scanning microscope resolution using a nano-antenna enhanced C-shaped ridge nano-aperture", *Accepted for Scanning Microscopies 2011: Advanced Microscopy Technologies for Defense, Homeland Security, Forensic, Life, Environmental, and Industrial Sciences* (2011).
67. J. Wilde, J. Goodman, Y. Eldar, and Y. Takashima, "Grating-Enhanced Coherent Imaging," in Optics in the Life Sciences, OSA Technical Digest (CD) (Optical Society of America, 2011), paper NMA3.
68. S. Yen, Y. Takashima, M. Tendulkar, J. R. Jameson, Y. Nishi, L. G. Kazovsky. "Quasi passive optical Switch based on transition metal oxide device" oral presentation, CLEO, Baltimore, MD (2011).
69. Y. Takashima. "A Systematic Comparison of Bit-based and Page-based Holographic Storage Systems". **Invited Paper** in Optical Data Storage Topical Meeting, Colorado, (2010).
70. A. Koç, Y. Takashima, and L. Hesselink, "Systematic analysis of the validity regions of scalar diffraction integral and angular spectrum method," in Biomedical Optics and 3-D Imaging, OSA Technical Digest (CD) (Optical Society of America, 2010), paper JMA4.
71. Y. Takashima, L. Hesselink, "Design and implementation of recording and readout system for micro-holographic optical data storage" *Proc. SPIE*, **7786**:7786B-1, (2010).
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77. Y. Takashima and L. Hesselink. "En-squared power based optical design for holographic storage systems". *Proc. SPIE*, **6342**:63421B, (2006).
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79. S. S. Orlov, E. Bjornson, W. Phillips, Y. Takashima, X. Li, L Hesselink, "High transfer rate (1 Gbit/sec) high-capacity holographic disk digital data storage system". **Invited paper** in *Conference on Lasers and Electro-Optics*, CTuC4, (2000).
80. Y. Takashima and S. Murai, "Development of CCD micro camera system and its optical design". **Invited paper** in *JSAP 44th spring meeting, symposium of Frontier in Optical Designs*, Optics Design (in Japanese), **12**:78, (1997).
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82. Y. Yamagata, T. Higuchi; Y. Takashima, K. Ueda. "Fabrication of micromechanical and optical components by ultra precision cutting". *Proc. SPIE*, **2881**, (1996).
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85. Y. Takashima, K. Ueda, E. Koike, E. Okumura, H. Arikawa, "Numerical analysis on far-field patterns of optical antennas for space telecommunications". In *Proceedings of Japanese Society of Applied Physics*, v39, part 3, p788 (1992).

News Articles:

Bo E. Miller, Yuzuru Takashima, "Enabling energy-efficient holographic optical storage for cold data." SPIE Newsroom. doi:10.1117/2.1201610.006728.

Invited Conference Presentations

1. Y. Takashima, B. Smith, B. Hellman, A. Gin, G. Chen, P. Winkler, Y. Kim, "Imaging Lidar (**Invited Talk**)", OSA Imaging Congress 2017.
2. Nicholas Mennona, Chuan Luo, Guang-hao Chen, Sunglin Wang, Chris Summitt, and Yuzuru Takashima "Interactive Graphical User Interface for Ray Aberration Generator 3.0 (**Invited Talk**)" presented at Research Experience for Undergraduates Symposium October 22-23 2017, (http://www.cur.org/conferences_and_events/student_events/reu/)
3. Yuzuru Takashima and Bo Miller "Recent Progress towards Practical Holographic Digital Data Storage System (**Invited Talk**)", in Optical Memories for Big Data Storage, The International Symposium on Optoelectronic Technology and Application(OTA 2016) Beijing, China, 9-11 May, (2016)
4. Y. Takashima, "Optical Compensation and Enhancement Techniques for Holographic Digital Data Storage System" (**Invited Talk**), SPIE Optics and Photonics, Optical Data Storage 2014.
5. Y. Takashima, L. Hesselink "Design and Implementation of Wearable Head-up Display for Mobile Phone Applications" (**Invited Talk**), CC3DR, Seoul Korea, (2012).
6. Y. Takashima, L. Hesselink "Wearable Head-up Display for Augmenting Visual Imagery" (**Invited Talk**) OSA Topical Meeting in Digital Holography and Three dimensional Imaging, Tokyo Japan, (2011).

Contributed Conference Presentations

7. P. Cameron, B. Hellman, J. Rodriguez, and Y. Takashima," MEMS Based Beam Steering for Holographic LIDAR Systems, "Council on Undergraduate Research, Research Experiences for Undergraduates Symposium, October 28-29, 2018.
8. Yuzuru Takashima, Young-Sik Kim, Chris Summitt, Sunglin Wang, "Fast and End-to-end X-ray Differential Phase Contrast Imaging Simulator" SPIE Optical Design and Engineering V, Friedrich-Schiller-University, Jena, Germany, 7 - 10 September (2015)
9. Yuzuru Takashima, Young-Sik Kim, Chris Summitt, Sunglin Wang, "Design and Optimization of Single Grating X-ray Differential Phase Contrast Imaging System with Free-form and Micro-optics-channeled Detector Array" SPIE Optical Design and Engineering V, Friedrich-Schiller-University, Jena, Germany, 7 - 10 September (2015)
10. Yuzuru Takashima, Young-Sik Kim, Chris Summitt, Sunglin Wang, "Design of Photonic-channeled X-ray Detector Array for Single Grating X-ray Differential Phase Contrast Imaging System", SPIE Optics and Photonics, Radiation Detectors: Systems and Applications XVI (2015)
11. Yuzuru Takashima, Young-Sik Kim, Jihun Kim," Title: Design of X-ray Differential Phase Contrast Imaging System for High Energy and Incoherent X-ray Sources", SPIE Optics and Photonics, Radiation Detectors: Systems and Applications XVI (2015)
12. Young-Sik Kim, Chris Summitt, Sunglin Wang, Max Yuen, Charles Qi, Lambertus Hesselink, Yuzuru Takashima." Virtual X-ray Differential Phase Contrast Imaging System Simulator", SPIE Optics and Photonics, Advances in X-Ray/EUV Optics and Components X (2015)

2011 and Before

13. Y. Cheng, Y. Takashima, J. R. Maldonado, D. Ferranti, W. Thompson, L. Hesselink and R.F. Pease “Crisp, high aspect-ratio, C-shaped nanoapertures fabricated in evaporated aluminum using focused helium ions”, The 55th International Conference on Electron, Ion, and Photon Beam Technology and Nanofabrication, Las Vegas, Nevada (2011)
14. R. Dinyari, Y. Takashima and P. Peumans, “A Curvable Silicon Retinal Implant”, In Poster Session of Stanford Center for Integrated Systems, Fall Advisory Committee Meetings, Stanford CA, (2010)
15. Y. Takashima, Y. Cheng, P. Hansen, Y. Yuen, L. Hesselink, R. F. Pease, J. R. Maldonado and P. A. Pianetta. "Demonstration of $\lambda/50$ optical spot using a C-Aperture Nano Tip for Electron Photo-emitter applications". **Invited Talk** in *Annual Symposium of Stanford Photonics Research Center*, Stanford CA, (2010)
16. Y. Takashima and L. Hesselink, “Design and implementation of recording and readout system for micro holographic optical data storage”. In *Current Developments in Lens Design and Optical Engineering XI*, San Diego, California (2010).
17. Y. Takashima. “A Systematic Comparison of Bit-based and Page-based Holographic Storage Systems”. **Invited Talk** in *Optical Data Storage Topical Meeting*, Colorado, (2010).
18. Y. Takashima, Y. Cheng, P. Hansen, Y. Yuen, B. Leen and L. Hesselink. "Experimental Demonstration of a Spot Size of $\lambda/50$ by Novel NSOM Probe: C-Aperture Nano-Tip". In *2nd Annual Center for Biomedical Imaging at Stanford Symposium*, (2010).
19. A. Koc, Y. Takashima and L. Hesselink. “Systematic analysis of the validity regions of scalar diffraction integral and angular spectrum method”. In *Digital Holography and Three-Dimensional Imaging*, Florida, (2010).
20. L. B. Rad, Y. Takashima, P. Pianetta, J. Miao and F. Pease. “Iterative Phase Recovery Using Wavelet Domain Constraints”. In *The 53rd International Conference on electron, ion and photon beam technology and nanofabrication*, (2009).
21. L. B. Rad, Y. Takashima, P. Pianetta, J. Miao and F. Pease. “Iterative Phase Recovery Using Wavelet Domain Constraints”. In *Bernard M. Gordon Center for Subsurface Sensing and Imaging Systems (Gordon-CenSSIS), Research and Industry Collaboration Conference*, (2009)
22. Y. Takashima and L. Hesselink. “Design and tolerance of two-element NA 0.8 objective lenses for page-based holographic data storage systems”. In *SPIE Optics and Photonics*, (2009).
23. Y. Takashima and L. Hesselink. “Design and tolerance of two-element NA 0.8 objective lenses for page-based holographic data storage systems”. In *International Society of Optical Memory /Optical Data Storage*, (2008).
24. L. Hesselink and Y. Takashima. “Holographic data storage systems”. **Invited talk** in *60th Technical Association of Graphical Art Annual Technical Conference*, (2008).
25. Y. Takashima and L. Hesselink. “Ultra High NA Fourier Transform Lenses for Optical Data Storages”. In *Stanford Photonics Research Center Annual Meeting*, (2007).
26. Y. Takashima and L. Hesselink. “Holographic data storage (HDS): Comparison of two approaches: page-based and bit-based HDS”. **Invited talk** in *MEDIA-TECH showcase and conference* (2006).
27. Y. Takashima and L. Hesselink. “Optical design for bit-based and page-based holographic data storage systems”. In *Stanford Photonics Research Center Annual Meeting*, (2006).
28. Y. Takashima, S. S. Orlov and L. Hesselink, “Optical design for holographic data storage system”. In *Stanford Photonics Research Center Annual Meeting*, (2004).
29. Y. Takashima, S. S. Orlov, R. Snyder and L. Hesselink. “Large field and low aberration Fourier transform lens system for photo-polymer disk-based HDS”. **Invited talk** in *International Workshop on Holographic Data Storage*, (1999).
30. Y. Takashima, S. S. Orlov, and L. Hesselink. “Large field and low aberration Fourier transform lens system for photo-polymer disk-based HDS”. in *National Storage Industry Consortium PRISM/HDSS Quarterly Meeting*, (1999).
31. Y. Takashima, S. S. Orlov, R. Snyder and L. Hesselink. “Large field and low aberration Fourier transform lens system for photo-polymer disk-based HDS (2)”. in *National Storage Industry Consortium PRISM/HDSS Quarterly Meeting*, (1999).

Invited Lectures

1. Yuzuru Takashima “Recent Trend in Plastic Optics”, Mitsti Chemical, March 8 (2019)

1. Yuzuru Takashima “3D Imaging and LIDAR (**Invited Lecture**)”, O-film Corporation, May 26, (2017).
2. Yuzuru Takashima “Optics in Future, Robotics, Artificial and Virtual Reality (**Invited Lecture**)”, O-film Corporation, Nov 17, (2016).
3. Yuzuru Takashima “Introduction to Optical Design (**Invited Lecture**)”, Utsunomiya University, Japan December, (2015).
4. Young-Sik Kim, Chris Summitt, Sunglin Wang, Max Yuen, Charles Qi, Lambertus Hesselink, Yuzuru Takashima.” Young-Sik Kim, Chris Summitt, Sunglin Wang, Max Yuen, Charles Qi, Lambertus Hesselink, Yuzuru Takashima. “Novel 3D Differential Phase Contrast Imaging System (**Invited Lecture**)”, Korea Basic Science Institute, June 18 (2015).
5. Yuzuru Takashima,” Nano-photonic Devices beyond Near-field Applications (**Invited Lecture**)” Utsunomiya University, Japan December, (2012).

Review Articles

1. Y. Takashima, A. Amano and M. Kitamura, “Ultra precision Machining for Optical Elements (In Japanese)”. *Toshiba Review*, vol. 52 no. 7, 55-58 (1997).
2. “Holographic Optical Elements (In Japanese)”. *Toshiba Review*, vol. 52 no. 3, (1997).
3. Y. Honguh, H. Mihara and Y. Takashima, “Illumination Optics for Liquid Crystal Projectors (In Japanese)”. *Toshiba Review*, vol. 53 no. 8, 39-42 (1998).

Patents Granted

1. USP 9,772,407, Photonic-Channeled X-ray Detector Array (9/26/2017).
2. US9869861B2, Glass implemented display (1/16/2018)

(At Stanford)

3. USP 8,374,068, Y. Takashima, Focusing and imaging compatible objective lenses for pixel-based and/or bit-based optical data recording and retrieval (2013).
4. USP 8,196,217, Y. Cheng, Y. Yuen, P. C. Hansen, T. Takashima, L. Hesselink, Tip-enhanced resonant apertures (2012).
5. USP 8,136,967, M. Weaver, Y. Takashima, LED Optical Lens (2012).
6. USP 6,264,332, Y. Honguh, Y. Takashima, H. Mihara, M. Kitamura, Illumination apparatus and a projection type image display apparatus using it (2001).

Patent Applications (All at U of A)

1. Single-chip ASLM (UA18-007)
2. Fast and Scalable Fabrication of Microoptic Optical Surfaces and its Application for Optical Interconnect Devices (UA18-004, Provisional Application 62/530,017)
3. Single-Chip Streak Camera (UA17-158) PCT application filed on April 14, 2017
4. DMD-Based Beam Steering (UA17-157) PCT application filed on April 14, 2017
5. Angular Spatial Light Modulation Device (UA17-156) PCT application filed on April 14, 2017
6. Optical Information Recording/Reproducing Apparatus, Optical Information Recording/Reproducing Method (PCT/US2014/041438).
7. Optical Information Processing Apparatus and Method (PCT/US2014/051233).
8. Single Grating X-ray Differential Phase Contrast Imaging System, (US62324326).
9. Eye-glass Mounted Display (US20130009853)
10. Range-finder Apparatus, Methods, and Applications, (PCT/US16/47767)
11. Pseudo Phase Conjugate Image Transfer Device, (PCT/US2016/041599)
12. Wavelength Diversity Detection for Holographic Data Storage System, The University of Arizona

Disclosure: UA16-029. Filing scheduled on Sept 30, 2016.

Japanese Patent (5 Granted Patents)

Patent

- | | |
|----------------|--|
| 1. 3792883 | Lighting System and Projection Display Device By Using It |
| 2. JP3333679B2 | Groove Cutting Method |
| 3. JP2994229B2 | Endoscope |
| 4. JP2974644B2 | Reflecting and Refracting Optical Lens and Its Manufacture |
| 5. JP2854781B2 | Optical Equipment |

Japanese Patent Applications (25 Applications)

Publication

- | | |
|-----------------------|--|
| 6. 2002-247453 | Image Pickup Device and Portable Phone |
| 7. 2001-242377 | Lens and Camera Module |
| 8. 2001-183601 | Picture Projector |
| 9. 2000-275547 | Endoscope and Its Manufacture |
| 10. 11-282073, (1999) | Card Type Camera |
| 11. 11-183794, (1999) | Optical Lens |
| 12. 11-183706, (1999) | Highly Integrated Optical Element and Its Production |
| 13. 11-025705, (1999) | Projection Apparatus and Prism Body |
| 14. 10-321027, (1998) | Polarized Light Optical Element, Polarized Light Optical System, and Projection Device |
| 15. 10-321004, (1998) | Polarization Optical Element, Polarization Optical System, and Projection Device |
| 16. 10-206621, (1998) | Manufacture of Holographic Optical Element |
| 17. 10-206618, (1998) | Processing Method of Blazed Diffraction Grating |
| 18. 10-197948, (1998) | Projection Device |
| 19. 10-186301, (1998) | Liquid Crystal Projection Device |
| 20. 10-083448, (1998) | Optical Device |
| 21. 10-062715, (1998) | Liquid Crystal Projection Device |
| 22. 06-347699, (1994) | Optical Element and Optical Device |
| 23. 06-273678, (1994) | Diffusing and Illuminating Optical System For Endoscope |
| 24. 06-027389, (1994) | Optical Observation Device |
| 25. 06-027371, (1994) | Optical Observation Device |
| 26. 06-011637, (1994) | Optical Device |
| 27. 06-011603, (1994) | Optical Parts and Their Production |
| 28. 05-288908, (1993) | Optical System |
| 29. 05-151502, (1993) | Rotary Scan Type Magnetic Recording and Reproducing Device |
| 30. 05-072477, (1993) | Afocal Optical Device |

Grants and Contracts: \$998,637 At the University of Arizona, 2011~2016

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|---|--|--------------|
| 1. TRIF LINK Award (2017) | | |
| 2. Tech Launch Arizona: DMD Imaging LIDAR (PI, 5%), State Funding (\$54,828) | | 2015-Current |
| 3. TRIF: Ray Aberration Generator 2.0 (PI, 5%), State Funding (\$5,604) | | 2016 |
| 4. Hitachi: Modeling of Thermal and Mechanical Effects on High-density and Hi-capacity Angular Multiplexed Holographic Data Storage System (PI, 15%) Industrial Funding (\$410,000) | | 2012-Current |
| 5. Stanford University: Optical Modeling of Novel X-Ray Differential Phase-Contrast Imaging for Aviation Security (PI, 15%), Sub-contract (\$475,746) | | 2012-Current |
| 6. Intel: Micro mirror array fabrication by grayscale lithography tool, Phase II (PI, 5%) Industrial Funding (\$29,380) | | 2012 |
| 7. Intel: Micro mirror array fabrication by grayscale lithography tool, Phase I (PI, 5%) Industrial Funding (\$23,079) | | 2011 |

List of collaborators

Academia

- Milorad Cvijetic (UofA)
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- R. F. Pease (Stanford Univeristy)
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- Dan Pickard (National Singapore University)
- Joe Goodman (Stanford)
- Yoniner Elder (Technion)

Industry

- Jin Zang (Perkin Elmer Medical Imaging)
- Jim Cone (Comet X-ray Source)
- Sondre Skatter (Mprpho Detection)
- Taku Hoshizawa (Hitachi)