

Guodong Xie, Ph.D.

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Google Scholar: <https://scholar.google.com/citations?user=Kbnv-fAAAAAJ&hl=en> (>1500 citations)

EDUCATION

- Ph.D., **University of Southern California (USC)**, Los Angeles, CA 08/2012 – present
Projected thesis: Using beams carrying orbital angular momentum for communications and remote sensing
Thesis advisor: Professor Alan E. Willner
Major: Electrical Engineering (GPA: 4.0/4.0), Minor: Computer Science (GPA: 3.6/4.0)
- M.S., **Peking University (PKU)**, Beijing 08/2009 – 07/2012
Thesis: Experimental analysis of key technologies in optical wireless coherent communications
Thesis advisor: Professor Anhong Dang and Hong Guo
Major: Electrical Engineering (Overall GPA: 89.2/100, Major GPA: 90.2/100)
- B.E., **Beijing University of Posts and Telecommunications (BUPT)**, Beijing 09/2005 – 07/2009
Major: Electrical Engineering (Overall GPA: 89/100, Major GPA: 90.6/100)

WORKING PERMISSION

EAD and Advance Parole in hand; Green Card (I-485) being processed under EB-1A (extraordinary ability)

SELECTED AWARDS & HONORS

- 2017 IEEE Photonics Society Graduate Student Fellowship (10 Ph.D. students selected worldwide)
- 2017 Chinese-American Engineers and Scientists Scholarship (10 students selected in southern California)
- 2017 Scholarship for Outstanding Self-Financed Chinese Students Abroad (500 Ph.D. selected worldwide)
- 2016 Best Poster Award in USC Electrical Engineering Research Festival (2 selected out of 100)
- 2016 Ming Hsieh Institute Scholar, USC (5 selected among ~300 Ph.D. students)
- 2012 – 2016 Provost Fellowship, USC (4-year fellowship for top USC Ph.D. students)
- 2011 Leo Koguan Scholarship, Peking University (1 selected from ~70 Master's students)
- 2010 Excellent Student, Peking University (Top 5% students)
- 2009 – 2012 Graduate Fellowship, Peking University (3-year fellowship for top Master's students)
- 2009 Excellent Graduated Student of Beijing (Top 1% students)
- 2005 – 2008 National Scholarship of China (Top 1% students, three years in a row)
- 2005 – 2008 Excellent Student, Beijing U. of Posts and Telecom. (Top 5% students, three years in a row)

OVERVIEW

10-year experience on basic communication theory; 8-year hands-on experience on free-space optical (FSO) communications; 5-year hands-on experience on optical fiber and radio frequency (RF) communications; 1-year hands-on experience on optical sensing

- Designed and implemented **high-speed communication systems**:
 - 100-Tbit/s *free-space optical communication* through the combination of space division multiplexing (SDM), wavelength division multiplexing (WDM), and polarization division multiplexing (PDM)
 - 32-Gbit/s *millimeter-wave communication* using SDM and PDM at a single carrier frequency of 28 GHz
 - 40-Gbit/s *underwater communication* using SDM and PDM with blue/green light
 - 80-Gbit/s *few-mode fiber communication* using SDM
 - 80-Gbit/s FSO communication between *a flying UAV and the ground station* using SDM
- Investigated and designed **solutions to overcome challenges** of SDM based communication subsystems:
 - Modeled and designed guidelines to optimize system parameters for SDM based FSO links
 - Modeled and emulated beam propagation through atmospheric turbulence
 - Designed and implemented adaptive optics and for turbulence compensation
 - Implemented digital signal processing (DSP) algorithms for channel distortion compensation
 - Designed and demonstrated beam steering scheme for SDM based millimeter-wave communication link
 - Implemented the pointing, acquisition, tracking (PAT) subsystem for SDM based FSO link
 - Developed and demonstrated partial-aperture receiver scheme for SDM based FSO link

TECHNICAL SKILLS

- ***Transmitter, laser propagation (FSO), and receiver***
 - Hands-on experience on the generation of up to 50-Gbaud OOK/QPSK and 20-Gbaud 16-QAM/64-QAM signals in the optical domain, and up to 2-Gbaud OOK/QPSK and 16-QAM signals in the RF domain
 - Hands-on experience on turbulence measurements and turbulence compensation
 - Hands-on experience on optical signal propagation through single/few/multi mode fiber
 - Hands-on experience on real-time and offline signal processing, as well as signal-to-noise ratio (SNR), error vector magnitude (EVM) and bit-error-rate (BER) measurements
- ***Equipment operation***
 - Signal generation and detection*
 - High-speed arbitrary waveform generator
 - High-speed real-time oscilloscope
 - High-speed sampling oscilloscope
 - Electrical spectrum analyzer
 - Vector network analyzer (VNA)
 - Bit pattern generator & error analyzer
 - Optical transmitter and receiver*
 - Lasers (ECL, Fiber, DFB, and VCSEL)
 - Erbium-doped fiber amplifier (EDFA)
 - Optical filter
 - Optical spectrum analyzer
 - Optical modulator
 - Arrayed waveguide grating
 - Polarization controller
 - Optical modulation analyzer (OMA)
 - Photodetector
 - Polarization analyzer
 - Free-space optical device*
 - Spatial light modulator (SLM)
 - Wavefront sensor (WFS)
 - Fast steering mirror (FSM)
 - Beam expander
 - Diffraction grating
 - General devices (lens, mirror, & camera)
 - Radio frequency device*
 - Power divider
 - I-Q mixer
 - Parabolic antenna
 - Amplifier
 - Attenuator
 - Delay line
 - Special device*
 - Frequency resolved optical gating
 - Pointing, acquisition, tracking systems
 - Self-designed 2D RF beam profiler
 - Fiber splicer
- ***Software (Equipment control, modeling, data processing)***
 - Proficient in equipment control through GPIB, RS232, USB, and VGA/DVI ports
 - Proficient in device operating with LabVIEW and MATLAB
 - Proficient in system modeling using MATLAB and Simulink
 - Proficient in data processing with MATLAB, Python (NumPy and SciPy), and Java (including Hadoop)
 - Familiar with beam propagation software RSoft and optical communication software VPI
 - Familiar with various platforms: Windows, macOS, and Linux
- ***Project management and collaboration***
 - Played leading roles in projects funded by AFOSR, NSF, and ONR; Coordinated the work with PI, team members, and collaborators; Helped prepare project reports and review
 - Helped prepare >10 white papers and proposals for AFOSR, NSF, ONR, and Intel; Helped define work statements, determine milestones, and design proposal solutions
 - Collaborated and co-authored with worldwide renowned groups including: Caltech, Corning, Intel, MIT, NEC, NxGen Partners, University of Rochester, and Tel Aviv University; Led the collaboration with NxGen Patterns and NEC

RESEARCH PROJECTS

- ***High-capacity free-space optical communications***
 - Demonstrated a 100-Tbit/s link by multiplexing 24 orbital angular momentum (OAM) beams on each of the 42 WDM channels, which is the world-record capacity for FSO communication links
 - Explored the guidelines for the optimization to the system parameters of OAM multiplexing links based on

- the homemade free-space beam propagation model
- Developed various turbulence compensation approaches for OAM multiplexing link, including adaptive optics (WFS based and non WFS based) and DSP equalization algorithms
- Demonstrated OAM multiplexing for various scenarios: (a) 400-Gbit/s link for a 120-m transmission distance; (b) 40-Gbit/s link for a 2.4 m underwater link; (c) 80-Gbit/s link for a 100-m link between a flying UAV and a ground station
- Designed and demonstrated the SDM system using Laguerre-Gaussian modes with different azimuthal orders (OAM modes) as well as radial orders
- **Next generation wireless and millimeter-wave communications**
 - Demonstrated a 32-Gbit/s link by multiplexing 4 OAM beams on each of the two polarizations, which is the world-record capacity for millimeter wave communication links
 - Demonstrated beam forming/steering of data-carrying OAM beams using a circular antenna array
 - Simulated and analyzed wireless link performance, including path loss, link budget analysis, channel crosstalk, spectral efficiency and capacity
- **Structured electromagnetic waves for communications, imaging, and directed energy**
 - Modeled and verified the arbitrary control of the beam shape and position through coherent combination of a serial of complex-weighted OAM beams
 - Designed and demonstrated the remote sensing to object parameters (opening angle and orientation) by analyzing the complex OAM spectrum of the beam

PROFESSIONAL ACTIVITIES

Journal Reviewer: The Scientific World Journal (Hindawi Publishing); Optics Express (Optical Society of America); Optics Communication (Elsevier, *outstanding reviewer*), Wiley Encyclopedia of EEE (Wiley); Radio Science (Wiley); Applied Optics (Optical Society of America); Journal of Optical Society of American A (Optical Society of America); Photonics Journal (IEEE); IEEE Communication Letter (IEEE); Microwaves, Antennas & Propagation (Institution of Engineering. & Tech.); Optics Letters (Optical Society of America, *recognized reviewer*); IEEE Transactions on Wireless Communications (IEEE); Photonics (Molecular Diversity Preservation International); Photonic Network Communications (Springer); IEEE Transactions on Communication (IEEE); Chinese Optics Letters (Optical Society of America); IEEE Journal of Selected Areas in Communications (IEEE)

Conference Reviewer: IEEE GLOBECOM 2014; IEEE International Conference on Communications (ICC) 2015

PUBLICATIONS

- Published in high-impact journals: ***Nature Communications, Optica, Scientific Reports, and Optics Letters***
- Published **1** book chapter, **1** patent, **39** journal papers, and **60** conference papers
- First-author of **22** and the leading author (first, second or third author) of **64** of the **101** publications
- Publications been cited more than **1500** times by researchers from around the world

Book chapter: A. Willner, Y. Yan, Y. Ren, N. Ahmed, **G. Xie**, Signal Processing for 5G: Algorithms and Implementations, Chapter 13, Orbital angular momentum-based wireless communications: designs and implementations, John Wiley & Sons, 2016.

Patent: Y. Ren, **G. Xie**, et. al, “Adaptive optics based simultaneous turbulence compensation of multiple orbital angular momentum beams,” U.S. Patent Provisional 20,160,028,479, January 28, 2016. (Recently accepted by US Patent Office)

Selected journal publication (27/39, please see my Google Scholar for the full publication list)

1. **G. Xie**, et. al, “Spatial light structuring using a combination of multiple orthogonal orbital angular momentum beams with complex coefficients,” **Optics Letters**, vol. **42**, no. 5, pp. 991, 2017.
2. **G. Xie**, et. al, “Localization from the unique intensity gradient of an orbital-angular-momentum beam,” **Optics Letters**, vol. **42**, no. 3, pp. 395-398, 2017.
3. L. Li, **G. Xie**, et. al, “Power loss mitigation of orbital-angular-momentum-multiplexed free-space optical links using nonzero radial index Laguerre–Gaussian beams,” **Journal of Optical Society of America B**, vol. **34**, no. 1, pp. 1-6, 2017.

4. A. Willner, Y. Ren, **G. Xie**, et. al, "Recent advances in high-capacity free-space optical and radio-frequency communications using orbital angular momentum multiplexing," **Invited Paper, Philosophical Transactions of the Royal Society of London A**, vol. **375**, no. 2087, pp. 20150439, 2017.
5. Y. Ren, L. Li, **G. Xie**, et. al, "Line-of-sight millimeter-wave communications using orbital angular momentum multiplexing combined with conventional spatial multiplexing," **IEEE Transactions on Wireless Communications**, vol. **16**, no 5, pp. 3151, 2017.
6. Z. Zhao, Y. Ren, **G. Xie**, et. al, "Division and multiplication of the state order for data-carrying orbital angular momentum beams," **Invited Paper, Applied Physical Letters Photonics**, vol. **1**, no. 9, pp. 090802, 2016.
 - **No. 1 viewed paper of the journal in month of January, 2017**
7. **G. Xie**, et. al, "Demonstration of tunable steering and multiplexing of two 28 GHz data carrying orbital angular momentum beams using antenna array," **Scientific Reports**, vol. **6**, no. 37078, pp. 1-9, 2016.
8. **G. Xie**, et. al, "Experimental demonstration of a 200 Gbit/s free-space optical link by multiplexing Laguerre Gaussian beams with different radial indices," **Optics Letters**, vol. **41**, no. 15, pp. 3447-3450, 2016.
9. A. Willner, L. Li, **G. Xie**, et. al, "Orbital-angular-momentum-based reconfigurable optical switching and routing," **Invited Paper, Photonics Research**, vol. **4**, no. 7, pp. B5-B8, 2016.
 - **Selected by editors as the cover page of the issue**
10. L. Li, **G. Xie**, et. al, "Orbital-angular-momentum-multiplexed free-space optical communication link using transmitter lenses," **Applied Optics**, vol. **55**, no. 8, pp. 2098-2103, 2016.
11. H. Rubinsztein-Dunlop, et al., **G. Xie**, et al., "Roadmap on structured light," **Invited Paper, Journal of Optics**, vol. **19**, no. 1, pp. 013001, 2016.
12. **G. Xie**, et. al, "Phase correction for a distorted orbital angular momentum beam using a Zernike polynomials based stochastic-parallel-gradient-descent algorithm," **Optics Letters**, vol. **40**, no. 7, pp.1197-1200, 2015.
13. A. Willner, **G. Xie**, et. al, "Design challenges and guidelines for free-space optical communication links using orbital-angular-momentum multiplexing of multiple beams," **Invited Paper, Journal of Optics**, vol. **18**, no. 7, pp. 074014, 2016.
 - **Selected by editors as a highlight of 2016 in Journal of Optics**
14. **G. Xie**, et. al, "Performance metrics and design considerations for a free-space optical orbital-angular-momentum multiplexed communication link," **Optica**, vol. **2**, no. 4, pp. 357-365, 2015.
15. Y. Ren, Z. Wang, **G. Xie**, et. al, "Free-space optical communications using orbital-angular-momentum multiplexing combined with MIMO-based spatial multiplexing," **Optics Letters**, vol. **40**, no. 18, pp. 4190-4193, 2015.
16. Y. Ren, **G. Xie**, et. al, "Turbulence compensation of an orbital-angular-momentum and polarization multiplexed link using a data-carrying beacon on a separate wavelength," **Optics Letters**, vol. **40**, no. 10, pp. 2249-2252, 2015.
17. A. Willner, H. Huang, Y. Yan, Y. Ren, N. Ahmed, **G. Xie**, et. al, "Optical communications using orbital angular momentum beams," **Invited Paper, Advances in Optics and Photonics**, vol. **7**, no. 1, pp. 66-106, 2015.
18. A. J. Willner, Y. Ren, **G. Xie**, et. al, "Experimental Demonstration of 20 Gbit/s Data Encoding and 2 ns Channel Hopping using Orbital Angular Momentum Modes," **Optics Letters**, vol. **40**, no. 18, pp. 5810-5813, 2015.
 - **Selected by editors as one of two papers for that month to appear in OSA Spotlight on Optics**
19. H. Huang, Y. Ren, **G. Xie**, et. al, "Tunable orbital angular momentum mode filter based on optical geometric transformation," **Optics Letters**, vol. **39**, no. 6, pp. 1689-1692 (2014).
 - **#9 downloaded Optics Letters article in February 2014**
20. Y. Yan*, **G. Xie***, et. al, "High-capacity millimeter-wave communications with orbital-angular-momentum multiplexing," **Nature Communications**, vol. **5**, pp. 1-9, 2014.
 - ***These authors contribute equally to this work**
 - **#2 most read Nature Communications article in late September 2014**
21. H. Huang, **G. Xie**, et. al, "100 Tbit/s free-space data link enabled by three-dimensional multiplexing of orbital angular momentum, polarization, and wavelength," **Optics Letters**, vol. **39**, no. 2, pp. 197-200, 2014.
22. Y. Ren, **G. Xie**, et. al, "Adaptive optics compensation of multiple orbital angular momentum beams propagating through emulated atmospheric turbulence," **Optics Letters**, vol. **39**, no. 10, pp. 2845-2848, 2014.
 - **#2 downloaded Optics Letters article in June 2014**
23. Y. Ren, **G. Xie**, et. al, "Adaptive optics-based simultaneous pre-and post-turbulence compensation of multiple orbital-angular-momentum beams in a bidirectional free-space optical link," **Optica**, vol. **1**, no. 6, pp. 376-382, 2014.
24. H. Huang, Y. Cao, **G. Xie**, et. al, "Crosstalk mitigation in a free-space orbital angular momentum multiplexed communication link using 4×4 MIMO equalization," **Optics Letters**, vol. **39**, no. 16, pp. 4360-4363, 2014.
25. Y. Ren, H. Huang, **G. Xie**, et. al, "Atmospheric Turbulence Effects on the Performance of a Free Space Optical Link Employing Orbital Angular Momentum Multiplexing," **Optics Letters**, vol. **38**, no. 20, pp.4062-4065, 2013.
26. W. Wei, **G. Xie**, et. al, "High-speed and bias-free optical random number generator," **IEEE Photonics Technology Letters**, vol. **24**, no. 6, pp. 437-439, 2012.
27. **G. Xie**, et. al, "A novel polarization-multiplexing system for free-space optical links," **IEEE Photonics Technology Letters**, vol. **23**, no. 20, pp. 1484-1486, 2011.

Selected conference publication (22/60, please see my Google Scholar for the full publication list)

1. **G. Xie**, et. al, "Diffraction insensitive object parameter sensing using orbital angular momentum based spectral analysis," **Conference on Imaging and Applied Optics Congress**, paper CW1B.3, San Francisco, CA, 2017.
2. **G. Xie**, et. al, "Experimental demonstration of using orbital angular momentum based spatial spectrum analysis for object parameter estimation," **Conference on Lasers and Electro-Optics (CLEO)**, paper JW2A. 76, San Jose, CA, 2017.
3. **G. Xie**, et. al, "Experimental demonstration of localized energy density gain using coherent superposition of multiple structured orbital-angular-momentum modes," **Conference on Lasers and Electro-Optics (CLEO)**, paper STu1M. 4, San Jose, CA, 2016.
4. **G. Xie**, et. al, "Tunable generation and angular steering of a millimeter-wave orbital-angular-momentum beam using differential time delays in a circular antenna array," **International Communication Conference (ICC) 2016**, paper 1570225424, Kuala Lumpur, Malaysia, 2016.
5. **G. Xie**, et. al, "Exploiting the unique intensity gradient of an orbital-angular-momentum beam for accurate receiver alignment monitoring in a free-space communication link," **European Conference on Optical Communications (ECOC)**, paper We.3.6.2, Valencia, Spain, 2015.
6. **G. Xie**, et. al, "Performance metrics for a free-space communication link based on multiplexing of multiple orbital angular momentum beams with higher order radial indices," **Conference on Lasers and Electro-Optics (CLEO)**, paper JTh2A.62, San Jose, CA, 2015.
7. **G. Xie**, et. al, "Enhanced spectral efficiency of 2.36 bits/s/Hz using multiple layer overlay modulation for qpsk over a 14-km single mode fiber link," **Conference on Lasers and Electro-Optics (CLEO)**, paper SW1M.6, San Jose, CA, 2015.
8. **G. Xie**, et. al, "Experimental demonstration of using multi-layer-overlay technique for increasing spectral efficiency to 1.18 bits/s/Hz in a 3 Gbit/s signal over 4-km multimode fiber," **Conference on Lasers and Electro-Optics (CLEO)**, paper JTh2A.63, San Jose, CA, 2015.
9. **G. Xie**, et. al, "Experimental Analysis of Multiplexing/demultiplexing Laguerre Gaussian Beams with Different Radial Index," **Frontiers in Optics (FiO) 2014**, paper FTh4B.6, Tucson, AZ, 2014.
10. **G. Xie**, et. al, "Performance metrics and design parameters for an FSO communications link based on multiplexing of multiple orbital-angular-momentum beams," **IEEE Globecom 2014**, paper 1570005079, Austin, TX, 2014.
11. **G. Xie**, et. al, "Experimental comparison of single and double partial receiver apertures for recovering signals transmitted using orbital-angular-momentum," **Conference on Lasers and Electro-Optics (CLEO)**, paper SM3J.2, San Jose, CA, 2014.
12. **G. Xie**, et. al, "Experiment turbulence compensation of 50-Gbaud/s orbital-angular-momentum QPSK signals using intensity-only based spgd algorithm," **Conference on Optical Fiber Communications (OFC) and National Fiber Optics Engineers Conference (NFOEC)**, paper W1H.1, San Francisco, CA, 2014.
13. Y. Ren, L. Li, **G. Xie**, et. al, "Experimental demonstration of 16 Gbit/s millimeter-wave communications using MIMO processing of 2 oam modes on each of two transmitter/receiver antenna apertures," **IEEE Globecom 2014**, paper 1569944271, Austin, TX, 2014.
 - **2014 Globecom Best Paper Award (14 out of ~2100 submissions)**
14. Y. Ren, **G. Xie**, et. al, "1-Tbit/s orbital-angular-momentum multiplexed FSO link through emulated turbulence with a data-carrying beacon on a separate wavelength for compensation," **Frontiers in Optics (FiO) 2014**, paper FTh3B.7, Tucson, AZ, 2014.
15. Y. Yan, **G. Xie**, et. al, "Demonstration of 8-mode 32-gbit/s millimeter-wave free-space communication link using 4 orbital-angular-momentum modes on 2 polarizations," **International Communication Conference (ICC) 2014**, paper 1569835875, Sydney, Australia, 2014.
16. H. Huang, **G. Xie**, et. al, "Experimental demonstration of orbital-angular-momentum demultiplexing using an optical FFT in the spatial domain," **Conference on Lasers and Electro-Optics (CLEO)**, paper SM3J.6, San Jose, CA, 2014.
17. **G. Xie**, et. al, "Analysis of aperture size for partially receiving and de-multiplexing 100-Gbit/s optical orbital angular momentum channels over free-space link," **IEEE Globecom 2013**, paper 1569795545, Atlanta, GA, 2013.
18. Y. Ren, **G. Xie**, et. al, "Simultaneous turbulence compensation of multiple orbital-angular-momentum 100-gbit/s data channels using a Gaussian probe beam for wavefront sensing," **European Conference on Optical Communications (ECOC)**, paper We.3.D.1, London, Great Britain, 2013.
19. H. Huang, **G. Xie**, et. al, "4x4 MIMO equalization to mitigate crosstalk degradation in a four-channel free-space orbital-angular-momentum-multiplexed system," **European Conference on Optical Communications (ECOC)**, paper Th.1.C.4, London, Great Britain, 2013.
20. H. Huang, **G. Xie**, et. al, "100 Tbit/s free-space data link using orbital angular momentum mode division multiplexing combined with wavelength division multiplexing," **Conference on Optical Fiber Communications (OFC) and National Fiber Optics Engineers Conference (NFOEC)**, paper OTh4G.5, Anaheim, CA, 2013.
21. **G. Xie**, et. al, "Effects of atmosphere dominated phase fluctuation and intensity scintillation to DPSK system," **International Communication Conference (ICC) 2011**, paper 1569355345, Kyoto, Japan, 2011.
22. **G. Xie**, et. al, "Performance analysis of free space optical communication based on DPSK modulation," **Applications of Lasers for Sensing and Free Space Communications**, paper LSMC5, Optical Society of America, 2010.