YUXIANG LIU

Higgins Lab 110
Worcester Polytechnic Institute
100 Institute Road
Worcester, MA 01609-2280

508-831-4829
yliu11@wpi.edu

A. EDUCATION

2011 Ph.D. Mechanical Engineering
University of Maryland, College Park, MD, USA
GPA 4.0/4.0; *Advisor:* Prof. Miao Yu

2005 M.S. Precision Machinery and Instrumentation
University of Science and Technology of China, Hefei, Anhui, China
GPA: 84.25/100

2002 B.E. Measuring and Controlling Technique and Instrumentation
University of Science and Technology of China, Hefei, Anhui, China
GPA: 87.57/100 (*Top **1** out of 46*)

B. RESEARCH APPOINTMENTS

08/13 – present *Assistant Professor in Mechanical Engineering*
Worcester Polytechnic Institute, Worcester, MA 01609
Research: optofluidics, optical trapping, nanophotonics, cavity optomechanics

06/11 – 06/13 *Postdoctoral researcher (Advisor: Dr. Kartik Srinivasan)*
Center for Nanoscale Science and Technology (CNST), National Institute of Standards and Technology (NIST), Gaithersburg, MD, USA
Also affiliated with Institute for Research in Electronics and Applied Physics, University of Maryland, MD, USA
Research: Investigated light-matter interactions in on-chip nanophotonic structures and cavity optomechanical systems.

01/11 – 06/11 *Postdoctoral research associate (Advisor: Prof. Ji-xin Cheng)*
Weldon School of Biomedical Engineering, Purdue University, West Lafayette, IN, USA
Research: Investigated various nonlinear optical microscopy techniques and their biomedical applications.

08/05 –01/11 *Graduate Research Assistant (Advisor: Prof. Miao Yu)*

Department of Mechanical Engineering, University of Maryland (UMD), College Park, MD, USA
Research: Performed research on fiber optical tweezers, surface plasmonic devices based on optical fibers, and fiber optic sensors and sensing systems.

C. RESEARCH INTERESTS

Nanophotonics, optical tweezers, cavity optomechanics, optical MEMS/NEMS, fiber optic sensing systems, optofluidics, nonlinear optical microscopy

D. RESEARCH EXPERIENCE

- **Investigation of strong radiation pressure interactions in chip-scale cavity optomechancial systems** 06/12 - present
  Center for Nanoscale Science and Technology, NIST, Gaithersburg, MD
  - Fabricated microdisk cavity optomechanical devices with high optical and mechanical quality factors on silicon nitride substrates
  - Investigating electromagnetically induced transparency and amplification based on cavity optomechanical coupling in both 1300 nm and 980 nm wavelength bands
  - Studying slow light effects with cavity optomechanical coupling
  - Exploring wavelength conversion between 1300 nm and 980 nm bands via cavity optomechanics

- **Development of silicon-based cavity optomechanical devices for atomic force microscopy(AFM) applications** 06/11 - present
  Center for Nanoscale Science and Technology, NIST, Gaithersburg, MD
  - Independently fabricated cavity optomechanical sensors with a nanoscale cantilever integrated with a microdisk resonator
  - Fabricated dimpled fiber taper probes for interrogating nanophotonic devices
  - Measured and analyzed the optical and mechanical properties of the cantilever-disk cavity optomechanical sensors
  - Demonstrated experimentally a wide accessible cantilever stiffness range of over 4 orders of magnitude
  - Demonstrated a photodetector-limited displacement sensitivity of sub-fm/$(Hz)^{1/2}$ with the cantilever-disk cavity optomechanical devices
  - Calculated optomechanical coupling coefficients of the cantilever-disk cavity optomechanical sensors with FEM numerical simulation

- **Study of nanoparticles and biological samples with label-free nonlinear optical imaging methods and their biomedical applications** 01/11 - 06/11
  Weldon School of Biomedical Engineering, Purdue University, West Lafayette, IN
  - Investigated the transient absorption imaging signals to differentiate metallic and

semiconducting carbon nanotubes
- Independently imaged the metallic and semiconducting carbon nanotubes with atomic force microscopy (AFM)
- Discovered the high detection efficiency and polarization dependency of transient absorption microscopy of the metallic and semiconducting carbon nanotubes via comparison with AFM imaging
- Studied transient absorption microscopy of cytochrome c and red blood cells
- Investigated two-photon transient absorption imaging of gold nanoparticles
- Explored photothermal imaging of red blood cells and CHO cells and investigated separation of photothermal signals from transient absorption signals for biological samples.
- Investigated stimulated Raman loss (SRL) imaging of polystyrene beads and lipids
- Investigated coherent anti-Stokes Raman scattering (CARS) imaging of polystyrene beads, oil, lipids and CHO cells
- Set up and investigated an optical fiber based flow cytometry to detect fluorescent polystyrene beads and DiD labeled CHO cells

- **Investigation of superfocusing and optical trapping with an optical fiber based surface plasmonic lens** 01/09 - 01/11

  Sensors and Actuators Lab, University of Maryland, College Park, MD, USA
  - Conceptualized and designed a novel fiber based surface plasmonic (SP) lens for far-field superfocusing
  - Measured the 3D intensity distribution of the fiber based SP lenses to evaluate the focusing performance
  - Numerically investigated the superfocusing effects of the fiber based SP lens using OptiFDTD and FDTD Solutions
  - Successfully trapped a bacterium in three dimensions with an optical power lower than those in the published research by using the fiber based SP lens
  - Studied the trapping force enhancement due to the fiber based SP lens by modeling the 3D optical forces with the experimentally measured 3D intensity profiles

- **Study of micro-/nano-scale optical trapping based on optical fibers** 06/06 - 01/11

  Sensors and Actuators Lab, University of Maryland, College Park, MD, USA
  - Furthered the fundamental understanding of fiber optical tweezers and developed novel fiber optical trapping systems to enhance the capability and functionalities of fiber optical tweezers as micro- and nano-scale manipulators/sensors
  - Built up single fiber optical tweezers (SFOTs) for yeast cell trapping by fabricating tapered fibers with the heat-and-draw method
  - Independently designed and built up the inclined dual-fiber optical tweezers (DFOTs) on a microscope platform

- Successfully realized 3D optical trapping of silica beads and yeast cells using the inclined DFOTs
- Calibrated, for the first time, the trapping stiffness of the 3D trap created with the inclined DFOTs with two methods: the drag force method and power spectrum analysis method
- Investigated the performance of the 3D trap created with the inclined DFOTs by developing a numerical model and conducting a systematic simulation analysis
- Discovered a new phenomenon, the existence of multiple traps, of the inclined DFOTs system
- Realized multiple functionalities including beads separation, beads grouping, 2D and 3D beads stacking, alignment and rotation of glass rods, and optical binding of beads and glass rods with the discovered multiple traps
- Explained and understood the working principles of the multiple functionalities using the numerical simulations based on our models

- **Investigation of low-coherence interferometer based on phase modulation with micromachined mirrors** 04/09 – 08/09

  Sensors and Actuators Lab, University of Maryland, College Park, MD, USA
  - Fabricated fiber optic pressure sensors to assess a novel modulation and demodulation algorithm
  - Evaluated the performance of a tunable Fabry-Perot interferometer composed of a fiber endface and a micromachined movable mirror
  - Implemented the demodulation scheme based on humps and ditches in time-domain signals for pressure measurements
  - Assessed the influence of modulation depths and temperature fluctuations on the measurement results with the novel demodulation scheme and micromachined tunable Fabry-Perot interferometer

- **Development of optical fiber sensing system based on low-coherence interferometry for simultaneous pressure and strain field measurements on helicopter blades** 01/07 - 06/07

  Sensors and Actuators Lab, University of Maryland, College Park, MD, USA
  - Designed and fabricated fiber optic sensors for strain and pressure measurements
  - Designed and developed fiber optic systems to retrieve sensing signals from the fiber sensors
  - Calibrated the performance of a tunable Fabry-Perot interferometer
  - Mastered the working principles of low coherence interferometry
  - Studied and analyzed the static and dynamic performance of the fiber optic pressure and strain sensors
  - Implemented multiple fiber sensors and the fiber optic system on a rotation blade for simultaneous pressure and strain measurements in a spin test conducted in a

vacuum chamber

- **Development of a lab module on optical fiber acoustic sensor system for an undergraduate course (ENME 351 Electronics and Instrumentation II)** 09/06 - 02/07

  Sensors and Actuators Lab, University of Maryland, College Park, MD, USA
  - Independently fabricated optical fiber based microphones
  - Designed and developed the fiber optic systems for measuring acoustic signals
  - Trained a department staff in fabricating and maintaining the systems
  - Composed an 18-page lab manual including lab report problems

- **Development of miniaturized fiber optical pressure sensors with polymer diaphragms and glass capillaries** 01/06 – 06/06

  Sensors and Actuators Lab, University of Maryland, College Park, MD, USA
  - Initiated a fabrication process of fiber optic sensor by using polymer diaphragm and glass capillary
  - Explored measurements of intradiscal pressure in bull tails with the fabricated fiber pressure sensors

- **Research on the impact of atmospheric turbulence on the propagation of specially shaped optical beams** 08/05-06/06

  Intelligent Optics Lab, University of Maryland, College Park, MD, USA
  - Investigated numerically the propagation of exotic beams in turbulent atmosphere using a large number of phase screens
  - Evaluated the influence of the atmospheric turbulence on the beam shape and beam wander under different turbulence strengths and propagation distances

- **Fabrication of Fiber Bragg Gratings with Deep-UV laser writing** 08/05-07/07

  Sensors and Actuators Lab, University of Maryland, College Park, MD, USA
  - Independently fabricated fiber Bragg gratings using deep UV laser writing with both phase masks and prisms
  - Exhibited the fabrication process to the lab sessions in ENME 489R/808R Fiber Optics
  - Maintained the fabrication system (including a high pressure chamber for hydrogen doping, a deep UV solid state laser, and the alignment of optical path)

- **Investigation of optical driving of micro-devices fabricated with femtosecond laser two-photon fabrication** 08/03 – 06/05

  SPM Lab, University of Science and Technology of China, Hefei, Anhui, China
  - Independently investigated the principle of optically driven devices by numerical simulations

- Successfully realized trapping and rotation of microscale rotors with optical tweezers built from microscope objectives
- Designed and built up an experimental setup of optical tweezers based on a microscope platform
- Fabricated microscale rotors using two-photon polymerization

E. PUBLICATIONS & PRESENTATIONS

Refereed Journal Publications

(Note: 2011 ISI Impact Factors for the journals where I published:
Nature Nanotechnology, 27.270; *Optics Express*, 3.587; *Optics Letters*, 3.399; *Biomicrofluidics*, 3.366)

1. Yuxiang Liu*, Marcelo Davanco*, Vladimir Aksyuk, and Kartik Srinivasan, "Electromagnetically induced transparency and wideband wavelength conversion in silicon nitride microdisk optomechanical resonators," ***Physical Review Letters*** 110, 223603 (2013). (* equal contribution)
2. Yuxiang Liu, Felix Stief, and Miao Yu, "Subwavelength optical trapping with a fiber-based surface plasmonic lens," ***Optics Letters*** 38, 721-723 (2013).
   (Selected for publication in *the Virtual Journal for Biomedical Optics*, Editors: Andrew Dunn and Anthony Durkin, Vol. 8, Iss. 4, May 22, 2013).
3. Yuxiang Liu, Houxun Miao, Vladimir Aksyuk, and Kartik Srinivasan, "Wide cantilever stiffness range cavity optomechanical sensors for atomic force microscopy," ***Optics Express*** 20, 18268-18280 (2012).
4. Ling Tong, Yuxiang Liu, Bridget D. Dolash, Yookyung Jung, Mikhail N. Slipchenko, Donald E. Bergstrom, Ji-Xin Cheng, "Label-free Imaging of Semiconducting and Metallic Carbon Nanotubes in Cells and Mice Using Transient Absorption Microscopy," ***Nature Nanotechnology*** 7, 56-61 (2012).
   (Highlighted by *Nature Nanotechnology*, *Science Daily*, *Biophotonics*, *Microscope and Analysis*, *BioOptics World*, *Drug Discovery & Development*, and *Medgadget*.)
5. Yuxiang Liu, Hua Xu, Felix Stief, Nikolai Zhitenev, and Miao Yu, "Far-field superfocusing with an optical fiber based surface plasmonic lens made of nanoscale concentric annular slits," ***Optics Express*** 19, 20233-20243 (2011).
   (Featured in "Technology Review 2011: Photonics reaches from science to the consumer world" in the *Laser Focus World* magazine).
6. Yuxiang Liu and Miao Yu, "Optical Manipulation and Binding of Microrods with Multiple Traps Enabled in an Inclined Dual-fiber System," ***Biomicrofluidics*** 4, 043010 (2010). (Highlighted in the *News & Announcements from AIP Biomicrofluidics* in February 2011; among the top 20 downloaded papers on *Biomicrofluidics* in February-March 2011).
7. Yuxiang Liu and Miao Yu, "Multiple traps created with an inclined dual-fiber system," ***Optics Express*** 17, 21680-21690 (2009).
   (Selected for publication in *the Virtual Journal for Biomedical Optics*, Editor: Gregory W.

Faris, Vol. 4, Iss. 13, Dec. 2, 2009).

8. Yuxiang Liu and Miao Yu, "Investigation of inclined dual-fiber optical tweezers for 3D manipulation and force sensing," ***Optics Express*** 17, 13624-13638 (2009).
   (Selected for publication in *the Virtual Journal for Biomedical Optics*, Editor: Gregory W. Faris, Vol. 4, Iss. 10, Oct. 2, 2009).
9. X. M. Zhang, Yuxiang Liu, H. Bae, C. Pang, and M. Yu, "Phase modulation with micromachined resonant mirrors for low-coherence fiber-tip pressure sensors," ***Optics Express*** 17, 23965-23974 (2009).
10. Anding Zhu, Yuxiang Liu, Fei Wang, Wenhao Huang, "Calculation for Optical Drive of micro-propeller-shaped rotors," ***Opto-Electronic Engineering*** 32, 13-16 (2005) (in Chinese).

Journal Papers submitted and in preparation

1. Yuxiang Liu, Alexander Lacher, and Miao Yu, "Three-step demodulation combined with fiber optic low-coherence interferometry for strain and pressure measurements," in preparation.

Book Chapters

1. Yuxiang Liu and Miao Yu, "Fiber optical tweezers for manipulation and sensing of bioparticles," in **Handbook of Photonics for Biomedical Engineering**, Aaron H.-P. Ho, Donghyun Kim, and Michael G. Somekh eds. (Springer) (Forthcoming, 2013).

Refereed Conference Proceedings

1. Yuxiang Liu, Houxun Miao, Vladimir Aksyuk, and Kartik Srinivasan, "Wide stiffness range cavity optomechanical sensors for atomic force microscopy," in *Integrated Photonics Research, Silicon and Nanophotonics* (Colorado Springs, CO, June 17, 2012), OSA Technical Digest (optical Society of America, 2012), paper IW2C.5.
2. Yuxiang Liu, Houxun Miao, Vladimir Aksyuk, and Kartik Srinivasan, "Integrated cavity optomechanical sensors for atomic force microscopy," IEEE proceedings of Microsystems for Measurement and Instrumentation (MAMNA), (Annapolis, MD March 27, 2012), page 1-3.
3. Yuxiang Liu, Hua Xu, Felix Stief, Nicolai Zhitenev, and Miao Yu, "Surface Plasmonic Lens on a Single-mode Optical Fiber for Far-field Superfocusing," in *CLEO:2011 - Laser Applications to Photonic Applications* (Baltimore, MD, May 1, 2011), OSA Technical Digest (CD) (Optical Society of America, 2011), paper CMX5.
4. Yuxiang Liu and Miao Yu, "Inclined dual-fiber optical tweezers: modeling and experiments," in Optics + Photonics: Nanoscience + Engineering (San Diego, CA, August 20, 2009), *Proc. of SPIE*, Vol. 7400, Article No. 740027 (2009).
5. Yuxiang Liu and Miao Yu, "3D Optical Force Field of Inclined Fiber Optical Tweezers," in Conference on Lasers and Electro-Optics (CLEO) (Baltimore, MD, June 2 2009), OSA Technical Digest (CD) (Optical Society of America), Paper No. JTuD60 (2009).

6. Yuxiang Liu, Alexander Lacher, Gang Wang, Ashish Purekar, and Miao Yu, "Wireless fiber optic sensor system for strain and pressure measurements on a rotor blade," in Optics East (Boston, MA, September 9, 2007), Proc. SPIE, Vol. 6770, Article No. 67700Y (2007).
7. Yuxiang Liu and Miao Yu, "Fiber Optical Tweezers for Cell Manipulation and Force Sensing," in Conference on Lasers and Electro-Optics (CLEO) (Baltimore, MD, May 6, 2007), Paper No. CMAA6 (2007).
8. Yuxiang Liu and Miao Yu, "Three-dimensional fiber optical trap for cell manipulation and force measurement," in Smart Structures and Materials & Nondestructive Evaluation and Health Monitoring (San Diego, CA, March 18, 2007), *Proc. SPIE*, Vol. 6528, Article No. 65280Z (2007).
9. Zhong Chen, Yuxiang Liu, He Li, and Miao Yu, "Real-time demodulation scheme based on phase-shifting interferometry with error compensations for miniature Fabry-Perot acoustic sensors," in Smart Structures and Materials 2006 (San Diego, CA, February 26, 2006), *Proc. SPIE*, Vol. 6167, Article No. 61670N (2006).
10. Yuxiang Liu, Anding Zhu, and Wenhao Huang, "Theoretical calculation of light-induced forces and torques on complex microrotors," in Photonics Asia 2004 (Beijing, China, November 8, 2004), *Proc. SPIE*, Vol. 5641, pp. 255-263 (2004).

Other Presentations

1. (Poster Presentation) "100 MHz Atomic Force Microscopy Sensors with fm/(Hz)$^{1/2}$ Sensitivity via Integrated Cavity Optomechancis" in 19th Annual NIST Sigma Xi Postdoctoral Poster Presentation (National Institute of Standards and Technology, Gaithersburg, MD, Feb. 22, 2012).
2. (Poster Presentation) "Manipulation of Microscale and Nanoscale Particles with Fiber Optical Tweezers" in NCI-UMD (National Cancer Institute – University of Maryland) Workshop for Cancer Technology (National Institutes of Health, Bethesda, MD, June 15, 2010).
3. (Oral Presentation) "Inclined Dual-fiber Optical Tweezers," in the 2009 International OSA Network of Students (IONS) conference – North America (College Park, MD, September 29, 2009).

F. HONORS

- National Institute of Standards and Technology's American Recovery and Reinvestment Act (NIST-ARRA) Fellowship 2011-2013
- Department nominee (**one** per department) of the Mechanical Engineering for the Dean's Ph.D. Student Research Award competition, University of Maryland, USA 2010
- Ann G. Wylie Dissertation Fellowship, University of Maryland, USA 2008–2009
- Future Faculty Program Fellowship, University of Maryland, USA 2007–2009
- Second place of the Research Poster Contest in Mechanical Engineering Research Review Day, University of Maryland, USA 2007

- Guanghua Education Scholarship, University of Science and Technology of China (USTC), China 2004
- Outstanding Graduate Scholarship, USTC, China 2002
- Guo Moruo Scholarship (**highest** honor awarded to an undergraduate USTCer), USTC, China 2001
- National second prize and provincial first prize in the fourth Zhou Peiyuan Cup national contest on mechanics for undergraduate students, Beijing, China 2000
- Outstanding Student Scholarship (Third Grade), USTC, China 2000
- Outstanding Student Scholarship (First Grade) (**highest** scholarship for the class), USTC, China 1999
- Rongshida-Sanyo scholarship (**highest** scholarship for the class in the year), USTC, China 1998
- Outstanding Freshman Scholarship (Third Grade), USTC, China 1997

G. INVENTION DISCLOSURES

1. Miao Yu and Yuxiang Liu, Optical Fiber Based Surface Plasmonic Lens for Subwavelength Focusing, reported to the Office of Technology Commercialization, University of Maryland, 02/2010, Ref. No. PS-2010-018.
2. Miao Yu, Silas Carl Nesson, Yuxiang Liu, and Xuming Zhang, Ultra-Miniature Fiber-Optic Pressure Sensor Array System, reported to the Office of Technology Commercialization, University of Maryland, 02/2008, Ref. No. PS-2007-105.

H. PROFESSIONAL ACTIVITYES/AFFILIATIONS

- Member, Society of Photographic Instrumentation Engineers (SPIE) 2006-present
- Member, Optical Society of America (OSA) 2007-present
- Member, American Society of Mechanical Engineers (ASME) 2010-present
  - Journal paper reviews: Optics Letters; Optics Express; Biomicrofluidcs; Applied Optics, Biomedical Optics Express, Meccanica, IEEE Sensors Journal

I. TEACHING EXPERIENCE

Co-Lecturer — ENME 808C Advanced Topics in Sensors and Actuators — Spring 2010
(~ 20 graduate students)
Department of Mechanical Engineering, University of Maryland
- Taught 3 lectures in the semester
- Designed the lecture slides for the 3 lectures

Co- Instructor — ENME 489R/808R Fiber Optics — Spring 2009
(~ 30 senior undergraduate and graduate students)
Department of Mechanical Engineering, University of Maryland
- Taught all the lectures in the first half semester (9 weeks, 15 lectures)

- Designed all the homework problems in the first half semester
- Designed the midterm exam
- Built up and taught all the lab sessions (3 lab sessions in total)
- Graded midterm exam papers, homework and lab reports through the entire semester
- Held office hours (2 hours per week) through the entire semester

Co- Instructor ENES102 Statics Spring 2008
(~ 40 freshman and junior undergraduate students)
Department of Mechanical Engineering, University of Maryland

- Taught as a teaching practicum in partial fulfillment of the Future Faculty Program at University of Maryland
- Taught 25% of all the lectures (7 lectures in total)
- Supervised one two-hour-long recitation per week with the other instructor
- Designed 2 (out of 5~6) exam problems in both the midterm and final
- Graded 2 problems in both the midterm and final exam papers for two sessions (~80 students in total)
- Held office hours (2 hours per week) with the other instructor

Teaching Assistant ENME 489R/808R Fiber Optics Spring 2008 and Spring 2009
(~30 senior undergraduate and graduate students)
Department of Mechanical Engineering, University of Maryland

- Built up the experimental setups and taught all the lab sessions (3 lab sessions in total)
- Graded lab reports and homework through the entire semester
- Held office hours (2 hours per week) through the entire semester