

THE INSTITUTE OF OPTICS

INDUSTRIAL ASSOCIATES

Program & Resource Guide

Fall 2022

October 20-22



HAJIM
SCHOOL OF ENGINEERING
& APPLIED SCIENCES

UNIVERSITY of ROCHESTER

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Agenda

WEDNESDAY, OCTOBER 19, 2022

8:30 AM – 10:00 AM EDT

HYATT REGENCY ROCHESTER, 125 E MAIN ST, ROCHESTER, NY

8:30 – 10:00 AM Director’s Advisory Council (DAC) Meeting And Breakfast, By Invitation Only

THURSDAY, OCTOBER 20, 2022

07:45 AM – 8:00 PM EDT

HYATT REGENCY ROCHESTER, 125 E MAIN ST, ROCHESTER, NY

07:45 – 08:40 AM Networking Breakfast

08:45 – 09:00 AM Opening Remarks

Speaker: Elizabeth Rogan, Chief Executive Officer
Optica, USA

09:00 – 09:20 AM Opening Remarks

Speaker: Thomas G. Brown, Professor and Director
University of Rochester | The Institute of Optics

09:20 – 09:45 AM “Raman Spectroscopy of Bones in Human Hands” Research Presentation

Speaker: Andrew Berger, Professor
University of Rochester | The Institute of Optics

09:45 – 10:00 AM “Elevating Optics: Funding, Faculty, & Beyond” Presentation

Speaker: Sarah Mangelsdorf, President of the University of Rochester
University of Rochester

10:00 – 10:15 AM Master’s Student Showcase

University of Rochester Master’s Students | The Institute of Optics

10:15 – 11:10 AM Ph.D. Research Presentations

University of Rochester Ph.D. Students | The Institute of Optics

11:10 – 12:00 PM Student Poster Session

University of Rochester Undergraduate & Graduate Students | The Institute of Optics

12:00 – 01:00 PM Networking Lunch

01:00 – 01:15 PM Optica and SPIE Student Chapter Update

Speaker: Natalie Fullerman, Optica Chapter President
Speaker: Saleem Iqbal, SPIE Chapter President
University of Rochester | The Institute of Optics

01:15 – 01:45 PM “Alignment of the JWST at the Institute of Optics” Research Presentation

Speaker: James Fienup, Robert E. Hopkins Professor of Optics

University of Rochester | The Institute of Optics

01:45 – 02:10 PM “Working Together to Strengthen America’s Precision Optics Manufacturing Base” Industry Presentation

Speaker: Tom Battley

Vice President, Government and Partnerships, AmeriCOM

Executive Director, New York Photonics Cluster (NYPC)

02:10 – 3:00 PM Company Connection Showcase Introductions**MOVE TO ROCHESTER RIVERSIDE CONVENTION CENTER****3:00 – 8:00 PM EDT****JOSEPH A. FLOREANO ROCHESTER RIVERSIDE CONVENTION CENTER, 123 E MAIN ST, ROCHESTER, NY****03:00 – 03:30 PM Move to The Rochester Riverside Convention Center. Coffee & Refreshments Break.****03:30 – 05:30 PM Company Connection Showcase****04:45 – 05:30 PM Women In Optics Happy Hour hosted by the SPIE & Optica Student Chapters****05:30 – 08:00 PM Optica & SPIE Networking Reception****FRIDAY, OCTOBER 21, 2022****9:00 AM – 5:00 PM EDT****THE INSTITUTE OF OPTICS, 480 INTERCAMPUS DRIVE, ROCHESTER, NY****09:00 – 12:00 PM Company / Student Interviews****12:00 – 01:00 PM Interviewers Lunch****12:00 – 01:30 PM Industry & Faculty Research Lunch****01:00 – 05:00 PM Company / Student Interviews****SATURDAY, OCTOBER 22, 2022****8:00 AM – 12:00 PM EDT****THE INSTITUTE OF OPTICS, 480 INTERCAMPUS DRIVE, ROCHESTER, NY****08:00 – 12:00 PM Company / Student Interviews**

Message from the Director



*Thomas G. Brown, Director & Professor
The Institute of Optics*

Welcome to the Fall 2022 meeting of the Industrial Associates of the Institute of Optics. We especially welcome new members including AIM Photonics, Aperture Optical Sciences, Elbit Systems of America, KLA, NanoVox, RAM Photonics, and Northrup Grumman. Guest members include American Center for Optics Manufacturing, Andluca Technologies, Chronos Photonics LLC, Circle Optics, Inc., DRS Daylight Solutions, Greater Rochester Enterprise, Innovation Acceleration Capital, Lumentek Global, MACOM, MEETOPTICS, Physical Sciences Inc, Quantopticon, QuEra Computing, Stratio Technology, Supply Chain Optics and Vescent Photonics. It has been a productive and exciting time here at the Institute as we welcome our incoming undergraduate and graduate students. Our entering PhD class is close to a record, and the MS HOME program continues to grow. Over 350 students are now in the process of earning Optics or Optical Engineering degrees. Our Industrial Associates program is a big reason for our continued strong enrollment; both the students and the faculty appreciate the energy and opportunity that your participation brings to the programs, whether it is through instructional support, internship and employment opportunities, or just really good food.

In this meeting, you will have the opportunity to meet and hear from students at all levels. We will have PhD student presentations, hearing about the James Webb Space Telescope from Jim Fienup, about biomedical optics research from Andrew Berger, and hear from Tom Battley about the American Center for Optics Manufacturing and its mission to expand technician training. Our two flagship societies, SPIE and Optica, have continued to show amazing support and encouragement to our students, through scholarships and conference opportunities. As part of that, they have teamed together with us to provide a Women in Optics happy hour as part of our program today. We have added a new feature to our program on Friday, the faculty-industry lunch, which is a new opportunity to connect industry with faculty in areas of research of common interest.

In this meeting, we are also pleased and proud to announce a new initiative launched with the biggest gift commitment in the history of the Institute. A gift by Jim and Tammy Wyant will provide generous matching funds for the establishment of ten new faculty positions at the Institute of Optics. This campaign is considered the official launch of our centennial campaign to significantly increase both external and internal investment in optics at the University of Rochester by the time the Institute of Optics turns 100 years old in 2029. We are also honored to announce that Optica has become the first sponsor of the campaign and will establish a distinguished professorship in honor of Nobel Laureate and Institute Alum Donna Strickland.

We are also grateful to Optica for the opportunity to co-locate our symposium with an important conference such as FiO is a special treat, and we hope that those who attend our IA meeting will also come a day or so early and participate in the conference. Also co-located is the annual Vision meeting in which experts in visual science (including some great students and faculty at the Institute) will be contributing.

Finally, thanks to our Industrial Associate members and guest members for attending. We are thankful that our students have more opportunities than ever for productive and fulfilling careers. I am thankful for the Institute Staff who have worked so hard on putting this program together: Tal Haring manages our IA program and is the prime contact for member communication; Dustin Newman and Kai Davies facilitate your access to our students, including collecting Resumes, arranging for student transportation, and organizing the poster session; Lori Russell manages the staff; finally, Aylin Tunay is the event coordinator. Thank you, everyone!

Sincerely,

A handwritten signature in blue ink, appearing to read 'Tom Brown', written over a light blue horizontal line.

Tom Brown

Opening Remarks



Elizabeth (Liz) Rogan

Chief Executive Officer
Optica, USA

Short Biography

Elizabeth (Liz) Rogan was appointed Optica Chief Executive Officer in 2002. Previously, she served as the organization's Chief Operating Officer. From her earliest days with the association, Rogan listened to constituents to understand their areas of interest and suggestions. Her strong connection with the community and enthusiasm for exploring new opportunities have influenced the strategies she has helped bring to life.

Under Rogan's guidance, the Optica annual budget has grown to US\$50M, with 150 staff members. In 2002, she launched the Optica Foundation, a charitable entity that now has US\$150M in reserves. Her legacy covers the expansion of the society's global community to include more than 400,000 scientists, engineers, and business leaders as well as worldwide growth in membership, meetings, public affairs and publications.

In 2019, Rogan was named an Optica Fellow for outstanding long-term management of the society and leadership across the optics and photonics community, guiding extensive growth in programs, member engagement, diversity, inclusivity, and public policy. She was among the first class of Foreign Fellows of the Chinese Optical Society (COS). The COS Fellow designation is bestowed to those who have made notable contributions to the development of optics and photonics science and technology in China. In 2020/2021, Rogan's creativity and agile leadership during the COVID-19 crisis enabled Optica to quickly transition to virtual operations and service delivery so that programs could continue without interruption. Rogan is a CPA, an alumnus of the University of Connecticut, U.S., and a graduate of the University of Pennsylvania Wharton School of Business Executive Education Program.



Short Biography

Thomas G. Brown has been on the faculty of the Institute of Optics since July of 1987, has held the rank of full professor since 2008 and is currently the director of the Institute of Optics and a Mercer Brugler Distinguished Teaching Professor. Professor Brown is a Fellow of Optica and SPIE, is Editor in Chief of the Journal of Modern Optics, and serves as chair of the annual multidimensional microscopy conference (Photonics West). He was the founding director of the Robert E. Hopkins Center for Optical Design and Engineering, the architect of the optical engineering curriculum at the Institute of Optics, served as a program co-chair for the centennial program of Optica, and is former president and honorary member of the Rochester Local Chapter of Optica. He was foundational in establishing the plans for the Test, Assembly and Packaging program within AIM Photonics and currently serves and the academic co-lead for Test, Assembly and Packaging within AIM Photonics.

Thomas G. Brown

Professor and Director
The Institute of Optics,
University of Rochester

Presentations



Andrew Berger

Professor

The Institute of Optics | University of Rochester

Research Presentation

9:20 – 9:45 AM

Title: “Raman Spectroscopy of Bones in Human Hands”

Abstract:

Osteoporosis, the progressive weakening of bone quality, is a severely under-detected disease. Although the U.S. Preventive Services Task Force recommends that many women over 50, and all women over 65, get a diagnostic X-ray test, the screening rate is below 20%, leading to what has been called a "silent epidemic".

Raman spectroscopy, an inelastic scattering technique, can detect chemical signatures of bone in the human body through the skin, i.e. transcutaneously. This offers the possibility of a portable Raman-based instrument providing bone screenings in primary care settings as well as popup clinics in underserved locations. Such a device could identify patients at elevated risk, allowing doctors to provide X-ray referrals. This could potentially avoid many preventable bone fractures.

This talk will describe our group's work to develop the Raman methodology for such an instrument. The work thus far has included not only spectroscopic equipment and data analysis, but also Code V software, 3D printing, trifurcated fiber bundles, cadavers, dissections, and the breaking of wrists.

Biography:

Andrew Berger, professor of optics, arrived in Rochester in July, 2000. He holds physics degrees from Yale (BS, 1991) and MIT (PhD, 1998). At the latter, Dr. Berger did his doctoral work in the G.R. Harrison Spectroscopy Laboratory under the late Michael Feld, developing method to measure glucose and other chemicals' concentrations in blood using laser spectroscopy. Prior to coming to the Institute of Optics, he spent two years developing handheld systems to analyze breast tissue content at the Beckman Laser Institute and Medical Center in Irvine, CA, with Bruce Tromberg, thanks to a postdoctoral fellowship from the George E. Hewitt Foundation for Medical Research.

At Rochester, Professor Berger has been recognized with two of the university's college-wide teaching awards, the Goergen Award for Distinguished Achievement and Artistry in Undergraduate Teaching (2007) and the Edward Peck Curtis Award for Excellence in Undergraduate Teaching (2016). He spent the academic year 2013/14 in Jena, Germany, as a guest professor and research alumni fellow at the Leibniz Institute of Photonic Technologies and the Abbe Center of Photonics.

Contact Information: ajberger@optics.rochester.edu



Sarah C. Mangelsdorf

**President of the University of Rochester
University of Rochester**

**Leadership Presentation
9:45 – 10:00 AM**

Title: "Elevating Optics: Funding, Faculty, & Beyond"

Biography:

President Sarah C. Mangelsdorf, the University of Rochester's 11th president, is an experienced academic leader who is internationally known for her research on social and emotional personality development, and for her work on issues of academic quality, educational access, and diversity and inclusion.

A collaborative leader, Sarah elevated the University's status as a great place to work by raising the minimum wage to \$15 per hour, reorganizing human relations, and adeptly navigating the coronavirus pandemic.

Since arriving in July 2019, she has also increased the University's investment and growth in research and clinical enterprises, returned the University to its traditional university-wide commencement for the first time in 30 years, recognized Juneteenth as an official University holiday, and launched a new strategic planning process.

A fellow of the American Academy of Arts and Sciences, Sarah been co-chair of the American Association of Universities Advisory Board on Racial Equity in Higher Education since 2020 and serves on a select McKinsey & Company taskforce on the future of higher education.

A professor of psychology and a third-generation academic, she and her husband Karl Rosengren, a tenured developmental psychologist, have two adult daughters, and a son-in-law. Sarah enjoys learning about Rochester and engaging with the city by biking, running, and exploring the region's art, food, and music culture.



Saleem Iqbal

Ph.D. Candidate, Optics

The Institute of Optics | University of Rochester

UR SPIE Student Chapter President

Student Chapter update

1:00-1:15 PM

Title: “SPIE Student Chapter Update”

Biography:

Saleem is a PhD student in Bob Boyd’s group at the Institute of Optics where he studies nonlinear and quantum optics, particularly in the context of epsilon-near-zero effects, structured light, and microscopy. Born and raised in Las Cruces, NM, he holds a BS in Physics from the University of New Mexico. As president of the SPIE student chapter, Saleem looks to continue and strengthen chapter efforts in outreach, professional development, and initiatives aimed at supporting a diverse professional community in optics.

Contact Information: sigbal3@ur.rochester.edu

***Natalie Fullerman*****Undergraduate, Optics (BS anticipated '24)****The Institute of Optics | University of Rochester****Optica Student Chapter President****Student Chapter update****1:00-1:15 PM****Title: "Optica Student Chapter Update"****Biography:**

Natalie Fullerman is an undergraduate junior at the University of Rochester studying optical engineering. Her interests include lens/system design, spectroscopy, and hands-on hardware work, while constantly striving to broaden her horizons in optics. Natalie is the current President of the Optica Student Chapter at the University of Rochester, leading professional development, outreach, and social programming for the organization's members. Natalie will graduate in May 2024 with a Bachelor's Degree in Optical Engineering.

Contact Information: nfullerm@u.rochester.edu



James Fienup

Robert E. Hopkins Professor of Optics The Institute of Optics | University of Rochester

Research Presentation

1:15 – 1:45 PM

Title: “Alignment of the JWST at the Institute of Optics”

Abstract:

The James Webb Space Telescope (JWST) was launched, and the 18 segments making up its 6.5-meter primary mirror have been successfully aligned. For multiple stages of the alignment, NASA used phase retrieval algorithms that were developed over the preceding decades and made more robust at the Institute of Optics. This talk will describe phase-retrieval algorithms invented earlier for determining the aberrations of the Hubble Space Telescope, which were transitioned to the phasing of JWST, some of research performed here at the Institute, and the multiple other steps in aligning the mirror segments.

Biography:

James R. Fienup received an AB in physics and mathematics from Holy Cross College (Worcester, MA), and MS and PhD (1975) degrees in applied physics from Stanford University, where he was a National Science Foundation graduate fellow. He performed research for 27 years at the Environmental Research Institute of Michigan and Veridian Systems, where he was a senior scientist. He joined the faculty at the University of Rochester in 2002 as the Robert E. Hopkins Professor of Optics. Professor Fienup is a fellow of Optica and of the International Society for Optical Engineering (SPIE), and is a senior member of IEEE. He was awarded the Rudolf Kingslake Medal and Prize for 1979 by the SPIE, the International Prize in Optics for 1983 by the International Commission for Optics, the Emmett N. Leith Medal by Optica for 2013 and became a member of the National Academy of Engineering in 2012. He was a distinguished visiting scientist at the Jet Propulsion Laboratory in 2009. He was editor-in-chief of the Journal of the Optical Society of America A, 1997-2003. He previously served as division editor of Applied Optics - Information Processing, and associate editor of Optics Letters. One of his papers [J.R. Fienup, “Phase Retrieval Algorithms: a Comparison,” Appl. Opt. 21, 2758-2769 (1982)] has received over 6000 citations (Google Scholar) and is the most highly cited paper (out of over 50,000) in the journal Applied Optics.

Contact Information: fienup@optics.rochester.edu



Tom Battley

**Vice President, Government and Partnerships, AmeriCOM
Executive Director, New York Photonics Cluster (NYPC)**

**Industry Presentation
1:45 – 2:10 PM**

**Title: “Working Together to Strengthen America’s
Precision Optics Manufacturing Base”**

Abstract:

It is often said that we are in the century of the photon. Even during the pandemic demand for precision optics and the highly skilled technical talent that produce them increased. The intersecting vectors of retiring baby boomers, low unemployment, and low STEM and manufacturing interest among young people have made precision optics manufacturing a concern for the DOD. Can our industry work together cooperatively to solve this problem?

Biography:

Tom Battley is Vice President Government & Partnerships at the American Center for Optics Manufacturing (AmeriCOM), a DoD-funded not-for-profit whose mission is supply-chain stability, workforce development, and manufacturing innovation for America’s precision optics industry.

Battley was appointed, and still serves as Executive Director of the Rochester Regional Photonics Cluster (New York Photonics) in June, 2004. New York Photonics is the largest Optics and Photonics cluster in the United States, comprised of over 120 companies employing ~24,000 employees. The cluster includes companies large and small, research universities, and a network of educational partners mainly in the western New York region, all committed to growing the industry and creating a flourishing ecosystem for Optics and Photonics. In his role as executive director, Battley has initiated, executed, and managed collaborations across multiple partners in the region. He is recognized internationally for his role in guiding New York Photonics.

Prior to his role with New York Photonics Tom was Monroe County Economic Development Director for nine years, overseeing a staff responsible for assisting businesses in achieving their objectives using a variety of financial vehicles, tax incentives, and job training programs. During his tenure Monroe County participated in \$2.4 Billion in business investment in the Rochester Community, including major technology investments in Optics, Biotechnology, Telecommunications, and Advanced Manufacturing. In his Economic Development post in 1996, Battley not only drove the use of email and the internet, but was able to implement a multi-user CRM system in a county government environment, achieving increased efficiency, improved tracking, and improved communication between public and private banking staff and their customers, the region’s manufacturers.

Before being invited to join the Monroe County leadership team Tom was a co-founder, in 1986 of Teknic, Inc. Teknic designs, manufactures, and sells precision servo control products to the OEM

capital equipment market. The company has re-shored the manufacture of brushless servo motors and AC induction motors to Victor, NY (outside Rochester) for its line of intelligent motors.

Battley is a technology evangelist, advocate, and educational fundraiser excited to be promoting New York Photonics, the U.S. Optics and Photonics Industry, and serving the membership of New York Photonics in pursuit of their objectives: collaboration to develop a robust and qualified workforce; increasing the commercialization of new ideas; an increased number of contract opportunities for the membership, and the development of a healthy and growing New York State Optics and Photonics Industry.

Since 2004, as direct results under Tom's leadership, Rochester's OPI ecosystem has grown and flourished, including:

- Revitalization of the MCC Optical Systems Technology Program
- The Summer Sizzler, an optics immersion program for high school students and their teachers
- The establishment of dual credit optics programs with area high schools and MCC
- Regular international conferences; topical meetings for OPI manufacturers about best practices in everything from manufacturing and sales to ITAR compliance.
- Worked with regional, state and federal agencies to achieve new growth opportunities for light-based businesses in New York State.

Battley has a long track record of leading teams, growing organizations and establishing strong communication channels to achieve extraordinary results. When MCC's optics program was in danger of closing, Battley organized the industry response, scheduling tours, establishing the talking points, and driving the industry's agenda with the college. He raised an initial \$500k from Corning, Inc., found a \$250k match, established the industry advisory board, recruited faculty, established the first endowed professorship at the college, and set the stage for revitalization of the program. Today it is the leading program of its kind in the nation with record enrollment.

Tom's work with the New York Cluster has included advocating for the National Academies study Optics & Photonics: Essential Technologies for Our Nation and the National Photonics Initiative (NPI), which grew out of the study. This work led directly to the offering of the National Network for Manufacturing Innovation in Integrated Photonics, an opportunity with the Department of Defense and the Obama Administration. In July 2015, a team led by New York State was awarded the NNMI in Integrated Photonics, with Rochester designated as its headquarters: AIM Photonics.

Tom worked with the New York Cluster, the American Precision Optics Manufacturers Association (APOMA), and Rochester's Washington DC delegation on establishing AmeriCOM, the American Center for Optics Manufacturing in Rochester, New York.

In 2018 Battley convened the AmeriCOM Symposium, hosting New York Photonics and APOMA members, prime defense contractors, NAVAIR, AFRL and the Department of Defense Industrial Base Analysis and Sustainment to examine the vital importance of precision optics to the DoD, and validate the need for a Defense Precision Optics Consortium. AmeriCOM signed a five-year contract with DoD IBAS in April, 2021.

Master's Student Showcase

Yimin Xie



M.S. in optics, U of Rochester (anticipated May 2023)

B.S. in optical engineering, U of Rochester (received May 2021)

- Skilled in CodeV, LightTools, OptiLayer, MATLAB, AutoCAD
- Hands-on Lab experience in labs and in manufacturing and testing Lenses



Zhejiang University Exchange Program:

Research Assistant: Worked on different methods to distinguish the defects on the surface of optical components.

Southeast University Research Team:

Research Assistant: Worked on a large field-of-view collimator with integrated freeform surfaces used in a compact AR eyeglass system.

GCL System Integration Internship:

Optical Engineer: Worked on finding solutions for 3D display.

Suzhou BearSunny Technologies Internship:

Optical Engineer & Project manager: Lead projects in research, development, and testing of electrochromic glasses.



Objectives

Full-time positions after graduation, starting June 2023

Shler Irani

MS Student, U of Rochester

PhD Student, Plasma Physics, U of Alzahra

MS in Plasma Physics, UTMA

- Thesis: Self-focusing of a Gaussian Laser Pulse in an Unmagnetized Plasma
- Ranked the Top Student

Research Scholar, The Ohio State University

- Laser-Plasma/Material Interactions
- TA, Physics Mechanics



Objectives:

- Co-op Positions
- 2023 Summer Internships
- Research Positions

Prosper Liu

Education:

Master's Degree in Optics, University of Rochester (May 2024 Graduation)

Bachelor's Degree, New York University
Major in Economics, Minor in Business (NYU Stern)

Honors: University Honors Scholar

Work Experience :

More Photoelectric Precision Technology Ltd.
Optical Manufacturing Internship

- Custom AutoCAD Drafting
- Photoetching Experiments on Far -infrared Materials
- Optical Vacuum Coating (IR, Multi -broadband AR Coating) Trials
- Developing New Optical Grating Code
- UV-Vis Spectrophotometry Analysis



Well-Versed in AutoCAD, Python

Looking For:

2023 Spring (Co-op)/2023 Summer
Internship Opportunities in Optics Related Fields



Jing-Yi Wang



MS in Optics, U of Rochester

MS in Photonics, NCTU

- ✓ **Thesis:** A Study of **Optical Phases** in Polymer-Dispersed **Liquid Crystals**
- ✓ **Poster award** in annual meeting of PSROC
- ✓ **Outstanding contribution award** of NCTU Extracurricular Activities

BS in Physics, NTHU

- ✓ **Undergraduate project:** Saturation Absorption and Collision Effect of 40Ca^+



Garmin Corporation

Advanced Display and Optical Engineer II

Good grasp of Optics

- ✓ **Touch panel pattern design**
- ✓ **Display** optical characterization methodologies
- ✓ **Transparent solar cell** design, manufacture, failure analysis



NCTU TA (MATLAB, Mathematica)

The Language of Technical Computing



2023 full time job (graduate in Dec 2022) as **Optical design engineer**

Ph.D. Research Presentations



Ankur Desai, Optics PhD

Title: “Achromatization of multi-material gradient-index singlets”



Janet Hrdina Tang, Optics PhD

Title: “Time-resolved fluorescence imaging of the human eye”

Abstract: The fluorophores in the retina of the human eye can be measured using fluorescence lifetime imaging ophthalmoscope (FLIO). Investigations with a clinical FLIO have shown changes across the retina with age and disease. To understand the cellular-scale mechanisms of these changes as well as correcting for the eye's aberrations, our lab uses adaptive optics FLIO. Here, I discuss the quantitative relationship between clinical FLIO and AOFLIO to begin to translate our work to the clinic.



Micheal Rodriquez, Optics PhD

Title: “Spectral Mitosis of the Stokes Tone Generated by Two-tone Pumped Stimulated Brillouin Scattering using a Completely Spectrally Resolved Model”



Joseph Tang, Optics PhD

Title: “Improving phase retrieval algorithms for image-based wavefront sensing”

Abstract: Phase retrieval, more specifically image-based wavefront sensing, is a method of recovering exit pupil phase information from point spread function data. Phase retrieval plays a crucial role in primary mirror alignment for the James Webb Space Telescope. Joseph will be presenting a brief overview of his PhD thesis work, which focuses on improvements to the phase retrieval via nonlinear optimization algorithm, as well as exploring using machine learning in place of nonlinear optimization.



Martin Tangari, Optics PhD

Poster Competition

Voting by ballot in Regency Ballroom; voting ends at 1:00pm

Demetrious Dowdell, Optics PhD

Title: “**Shearing interferometry using a holographic reference mirror**”

Abstract: Testing steep aspheres and freeform surfaces has proven itself to be a challenging task. Conventional full aperture methods often utilize computer generated holograms with the traditional spherical reference surface. This work explores eliminating both the reference sphere and the computer-generated hologram using nulling reflection holograms in a Fizeau geometry. Preliminary results show that we can take an adequate measurement using in situ holographic exposures paired with shearing interferometry.

Kaitlin Dunn, Optics PhD

Title: “**Angular light scattering for estimating organelle size distributions in single cells**”

Abstract: Angular light scattering is sensitive to scatterer size and has been used to size populations of non-nuclear organelles in cellular ensembles. Our work pushes to bring light scattering-based organelle sizing to the single cell level to reveal information lost in ensemble measurements. We interferometrically obtain complex field images of light scattered by the sample using a Fourier phase microscope and then digitally Fourier transform this field to compute the sample’s angular scattering. The inverse problem of estimating organelle size distributions from angular scattering poses challenges including interference between light scattered by different organelles and undesired scattering at cell boundaries due to refractive index mismatch with immersion media. We have demonstrated that placing cells in index-matched immersion media reduces light scattering from the cell boundary, allowing us to obtain data more specific to organelle scattering. We are exploring several complementary strategies for investigating the fundamental limitations of extracting size information from single cells. These include using a physics-based simulation tool explore the accuracy with which angular scattering can be inverted to estimate size distributions, as well as using a simultaneous tomographic measurement of organelle sizes for comparison with angular scattering-based size estimates.

Yi-Ting Feng, Optics PhD

Title: “Can a bead emulate a single fluorescent molecule?”

Abstract: We study, through numerical and semi-analytical methods, how well a fluorescent bead of a given size, supplemented by a polarizer, can emulate a single fluorescent molecule in a microscopy setup.

Marissa Granados Baez, Optics PhD

Title: “Integrated photonics and 2D materials”

Abstract: We demonstrate room temperature lasing of monolayer WSe₂ integrated with a silicon nitride ring resonator. The monolayer, microring platform enables monolithic, on-chip, waveguide coupled light emission.

Anand Idris, Optical Engineering '23

Title: “LIDAR Inverse Image Reconstructions Using Convolutional Neural Networks”

Abstract: It is often the case that, when making an image of a scene, the only data that can be collected will show the effects of the imaging system on the resulting measurement, causing effects like noise and blur. Trying to reconstruct the original image, referred to as the ground truth, using the measured image is referred to as an inverse problem. Research in this area is currently looking for ways to perform image reconstruction using neural network architectures in machine learning. Existing methods using Convolutional Neural Networks (CNNs) use methods that give no quantification in how certain the algorithm is that its reconstruction is close to the original ground truth image. Our group has previously demonstrated success in using a Bayesian Neural Network to successfully reconstruct MRI images and quantify uncertainty. Our group is currently focusing on applying BNNs to LIDAR imaging. LIDAR, a method that allows one to both acquire an image as well as know how far away each element in the image is, has historically relied upon the aid of other imaging methods to supplement collected data in order to reconstruct the image. This makes LIDAR prone to uncertainty when reconstructing. Our proposed method would provide the user with a characterization of how certain the algorithm is that the reconstructed image is close to the original ground truth image. We use a convolutional neural network that takes histogram measurements of a scene using a Single Photon Avalanche Diode (SPAD) detector and uses this to reconstruct the original image. We are currently using a U-Net architecture, a form of Convolutional Neural Network designed to converge, and plan to extend this neural network to one that can quantify aleatoric and epistemic uncertainty.

Sushant Kumar, Optics PhD

Title: “Robust and Efficient PM Fiber to Chip Coupling”

Abstract: Electronics and laser are the two main sources of heat in a photonic transceiver. For high bandwidth and energy efficient operations, the photonic engine’s proximity to the electronics is non-negotiable. But the efficiency of lasers degrades under higher temperatures. With the thrust towards more efficient photonic modules and the advent of co-packaged optics, there has been a concerted push towards External Laser Sources (ESL) for datacenter and telecom applications. The ESL moves one of the two main sources of heat away from electronics, improving efficiency of both modules. But the ESL also requires connection to the photonic module via a polarization maintaining (PM) fiber due to polarization dependent nature of photonic chips. To this day, PM fiber connections are proving to be a major cost hinderance for mass application of ESL. We present a robust and efficient method for PM fiber to chip attach via laser fusion.

Vitek Stepien, Optics PhD

Title: “Impact of Finite Bandwidth on PRBS-modulated Optical Spectra”

Abstract: This paper reveals some limitations from the practical implementation of applying the pseudo-random binary sequence method to the modulation of optical spectra as a means to increase stimulated Brillouin scattering threshold in high power lasers. An improved way of quantifying the spectral width in this context is described.

Icel Sukovaty, Optical Engineering ‘23

Title: “Fiber Optical Coupling with Engineered Scattering Elements”

Abstract: Optical interconnects using a silicon-on-insulator integrated circuit platform have become the basis for many modern communications platforms. One limiting factor in interconnect technology is creating a consistent, reliable method for measuring the amount of coupled light from optical fibers into waveguides in a photonic integrated circuit. Monitoring the coupling efficiency before, during, and after would be the ideal scenario for fiber bonding. Using a foundry compatible engineered scattering element developed by our lab, we have been able to monitor the degree of fiber alignment by recording the relative power scattered by the engineered element. Recorded powers are then compiled to generate a heat map of the optimal fiber position for coupling. These scattering elements are also polarization sensitive, thus allowing for the fast axis of polarization maintaining fibers to be monitored and optimized for coupling.

Luheng Tang, Optics PhD

Title: “Femtosecond Laser Fabricated Superwicking Black Metal Panel for Ultra-efficient Solar-Thermal Desalination”

Abstract: Solar-based water desalination is an environmentally-friendly process for obtaining clean water that requires efficient light-to-heat-to-vapor generation. Here, we create a super-wicking and super-light-absorbing (SWSA) aluminum surface for efficient solar-based water desalination. The measure evaporation rate exceeds that of an ideal device operating at 100% efficiency, which we hypothesize resulted from a reduced enthalpy of vaporization within the microcapillaries. Limited solar absorber-water contact for water transport minimizes heat losses to bulk water and maximizes heat localization at the SWSA surface. The device can be mounted at any angle on a floating platform to optimized incident solar irradiance and can readily be integrated with commercial solar-thermal systems. Given the open capillary channels, the device surface can be easily cleaned and reused. Using the SWSA surface to purify contaminated water, we show a decrease in the level of contaminants to well below the WHO and EPA standards for drinkable water.

Wendao Xu, Optics PhD

Title: “Strong Optomechanical Interactions with Low-Frequency Fundamental Acoustic Modes”

Abstract: Many modern photonic devices based on stimulated Brillouin scattering benefit from long lifetimes of the participating acoustic waves. While long lifetimes can be enabled with lower resonant frequencies, these frequencies are restricted from widely used Brillouin systems by the higher order acoustic modes used for the interaction. The frequency of fundamental mode phonons, however, is at least an order of magnitude lower than the corresponding higher order modes. Here we demonstrate strong Forward Inter-Modal Brillouin scattering mediated by a Fundamental Acoustic mode (FIM-FAM) in an optical taper, enabling a promising new route for accessing application-desirable low-frequency phonons with long lifetimes.

Yi Zhang, Optics PhD

Title: “Engineered Second-Order Nonlinearity in Silicon Nitride”

Abstract: Silicon nitride (Si_3N_4) is a low-loss, CMOS-compatible material that has revolutionized many fields including integrated optics and nonlinear optics. So far, however, its application is limited because it lacks an electro-optic response. We present an approach to build permanent second-order nonlinearity in Si_3N_4 by electrically aligning the Si-N bonds and demonstrate non-trivial electro-optic response up to 15GHz modulation frequency.

Professional Organizations

SPIE Student Chapter

SPIE is the International Society for Optics and Photonics. The University of Rochester Student Chapter was established in 2009 and has since grown to be the largest student chapter in North America, with over 70 registered student and alumni chapter members. We promote optical science and engineering while supporting the professional development of our chapter members. To accomplish this, we regularly engage in optics outreach in the Rochester community, invite speakers to visit with students on campus, and schedule tours of local optics companies.

Current Officers:

President: Saleem Iqbal

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Faculty Advisor: Greg Schmidt

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If you would like to host a company tour or collaborate with us on outreach or professional development events, please contact urspie@gmail.com.

Optica Student Chapter

The University of Rochester's OPTICA student chapter is a pre-professional organization and academic club. Our mission is to promote and advance the science of light amongst the student body of the University of Rochester. One of our largest goals each year is to provide students with professional development opportunities aimed at giving them the skills they need to succeed. We have been working to find creative ways to engage with and teach optics to the campus and community at large, as well as host social events to promote interaction between students. Our biggest event of the year, bringing together Institute undergraduates, graduates, and faculty, is our annual Photon Cup soccer match with the Physics department.

Current Officers:

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Please contact the chapter at RochesterStudentOSA@gmail.com if you are interested in getting involved in our chapter programming through event sponsorships, company tours, talks and/or presentations.

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