THE INSTITUTE OF OPTICS

INDUSTRIAL ASSOCIATES

Program & Resource Guide

Spring 2022

March 30 – April 2

HAJIM SCHOOL OF ENGINEERING & APPLIED SCIENCES

UNIVERSITY of ROCHESTER

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Message from the Director

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

Welcome to the Spring 2022 meeting of the Industrial Associates of the Institute of Optics. We especially welcome new members including Amazon, Arizona Optical Metrology, Google, Soter Technology and Luminar Technologies. Guest members include Circle Optics, Elbit Systems of America, 2EyesVision, Layer Metrics, and Clear eye test. It has been a productive and exciting time here at the Institute, with new research awards, new undergraduate and graduate student, and strong shows of support from our worldwide optics community. We've continued with a healthy enrollment: Almost 300 students are in the process of earning Optics or Optical Engineering degrees. Our online MS (HOME) program is officially launched. Students have continued receiving early and multiple job offers; many of them are joining your companies as optical engineers and scientists. In this meeting you will have the opportunity to meet our students, and to hear from students at all levels. We particularly feature a series of talks on Freeform Gradient-Index Optics, a 'born in Rochester' concept coming from the laboratories of Prof. Greg Schmidt and Duncan Moore.

In December we received word that the SPIE foundation would provide a match for a PhD fellowship endowment of $1M. The check presentation was announced with great fanfare at Photonics West. Investments like this are investments in the future leadership of optics, and we are delighted to be able to team with SPIE on this. 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.

As we gather this year we have much to be thankful for. 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-Ustunkok has just joined our team as the event coordinator. Thank you everyone!

Sincerely,

Tom Brown
Interim Director
The Institute of Optics

Agenda

* Indicates a virtual attendance option.
Zoom Link: https://rochester.zoom.us/j/94933190434?pwd=a0YxbjdaTUN1ZDlLT0NkODhISzQ4dz09
Meeting ID: 949 3319 0434 | Passcode: 983149

WEDNESDAY, March 30, 2022 — 12:00 PM – 7:00 PM ET
Hyatt Regency Rochester, Downtown Rochester

12:00 – 03:00 PM	**Director's Advisory Council (DAC) Meeting and Luncheon, By Invitation Only**
05:30 – 07:00 PM	**Ceremony and Reception to Celebrate the Installation of Prof. Susana Marcos**

THURSDAY, March 31, 2022 — 07:45 AM – 7:30 PM ET
Hyatt Regency Rochester, Downtown Rochester

07:45 – 08:30 AM	**Breakfast**
08:30 – 09:00 AM	**Opening Remarks*** Speaker: Thomas G. Brown, Professor and Director University of Rochester | The Institute of Optics Speaker: Scott Carney, Professor University of Rochester | The Institute of Optics Chief Science and Technology Officer | Optica
09:00 – 09:20 AM	**"Freeform Gradient Index Optics" Research Presentation*** Speaker: Greg Schmidt, Assistant Professor University of Rochester | The Institute of Optics
09:20 – 09:40 AM	**"The Luminate Startup Accelerator: Foundation and Future" Industry Presentation*** Speaker: Damon Diehl, Technology Program Manager NextCorps | Luminate
09:45 – 10:00 AM	**Master's Student Showcase*** University of Rochester Master's Students | The Institute of Optics
10:00 – 10:15 AM	**Coffee Break**
10:15 – 11:00 AM	**Ph.D. Presentations*** University of Rochester Ph.D. Students | The Institute of Optics
11:00 – 12:00 PM	**Student Poster Session** University of Rochester Undergraduates & Graduates | The Institute of Optics
12:00 – 01:15 PM	**Lunch**

01:15 – 01:30 PM	**Optica and SPIE Student Chapter Update*** Speaker: Antony Georgiadis, Optica Chapter President Speaker: Saleem Iqbal, SPIE Chapter President University of Rochester | The Institute of Optics
01:30 – 01:50 PM	**"Femtosecond Optical Pulse Generation Without the Mode-locked Laser" Research Presentation*** Speaker: Will Renninger, Assistant Professor University of Rochester | The Institute of Optics
01:50 – 02:15 PM	**"Optical Fusion Splicing for Integrated Photonics Chips" Research Presentation*** Speaker: Juniyali Nauriyal, Ph.D. Candidate University of Rochester | Electronics and Communications Eng. Co-founder and CEO | Photonect Interconnect Solutions Speaker: Jaime Cardenas, Assistant Professor University of Rochester | The Institute of Optics
02:15 – 2:45 PM	**Senior Design Showcase Presentations***
02:45 – 03:00 PM	**Break, Companies Prepare for Showcase**
03:00 – 03:30 PM	**Company Connection Showcase Introductions**
03:30 – 05:00 PM	**Company Connection Showcase**
05:00 – 05:45 PM	**SPIE and OPTICA Women in Optics Happy Hour**
05:30 – 07:30 PM	**Cocktail Hour and Dinner Reception**

Friday, April 1, 2022 — 8:00 AM – 5:00 PM ET
The Institute of Optics, 480 Intercampus Drive

08:00 – 12:00 PM	**Company / Student Interviews**
12:00 – 01:00 PM	**Lunch**
01:00 – 05:00 PM	**Company / Student Interviews**

Saturday, April 2, 2022 — 8:00 AM – 12:00 PM ET
The Institute of Optics, 480 Intercampus Drive

08:00 – 12:00 PM	**Company / Student Interviews**

* Indicates a virtual attendance option.
Zoom Link: https://rochester.zoom.us/j/94933190434?pwd=a0YxbjdaTUN1ZDlLT0NkODhISzQ4dz09
Meeting ID: 949 3319 0434 | Passcode: 983149

Opening Remarks

Thomas G. Brown
Professor and Director
The Institute of Optics, University of Rochester
brown@optics.rochester.edu

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.

Research Overview

While at Rochester, he has conducted research in detectors and optical communications, semiconductor optoelectronics, optical fiber microstructures, optical polarization, and optical metrology. His early research focused on frequency-stable semiconductor laser design and silicon-based waveguide technology, including the first experimental observation of all-optical switching in a nonlinear Bragg reflector. Professor Brown's recent research activities have included: 1) Focusing and coherence properties of polarization vortex beams; 2) Stress-engineered optical elements; 3) Polarization properties of nanostructures; 4) Waveguide mode resonances in SOI waveguides. The work on polarization vortices has been applied to semiconductor lithography and inspection, and single molecule imaging [PRL 86, 5251 (2001)]. Professor Brown and colleagues have recently introduced the idea of a full Poincare beam, a fully correlated beam that contains every possible polarization state. His most cited work was published in 2000 (Optics Express) in which he coined the term ‘Cylindrical Vector Beam’ in analyzing the tight focusing properties of Radial and Azimuthally polarized beams.

P. Scott Carney
Professor and former Director
The Institute of Optics, University of Rochester
Chief Science and Technology Officer, Optica
scott.carney@rochester.edu

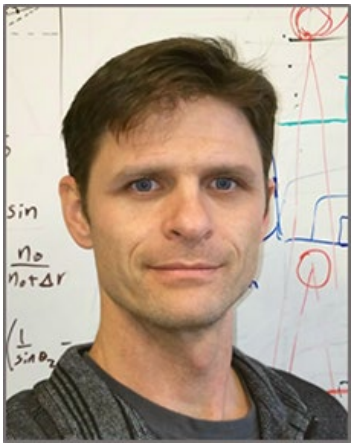
Short Biography

P. Scott Carney served as the director of The Institute of Optics, from 2017-2021. He holds a PhD in Physics (1999) from the University of Rochester and a bachelor’s degree in Engineering Physics (1994) from the University of Illinois Urbana-Champaign. He was faculty at ECE Illinois 2001-2017. Scott has a strong commitment to teaching excellence. He is active in the optics community primarily through Optica as the Chief Science and Technology Officer, a journal editor and meeting organizer. He is an entrepreneur and co-founder of Diagnostic Photonics, Inc.

Research Overview

Scott is primarily an applied theorist, but will do experiments in a pinch. He considers himself a generalist, but is lately focused on problems in computed imaging, spectroscopy, and coherence theory. His major career accomplishments include modeling of tip-sample interactions in near-field microscopy and the solution of related inverse problems, solution of the inverse problem for optical coherence tomography (OCT) and the subsequent invention of interferometric synthetic aperture microscopy (ISAM) and the recent development of synthetic optical holography (SOH). He has made contributions to spectroscopy and the correction of spectroscopic data to account for the effects of scattering and propagation. In addition to ongoing interest in all of these areas, he also maintains focus on problems in nonlinear enhanced spectroscopy.

Presentations



Greg Schmidt

Assistant Research Professor
The Institute of Optics | University of Rochester

Research Presentation
9:00 – 9:20 AM

Title: "Freeform Gradient Index Optics"

Abstract:

Advancements in optical material fabrication is rapidly growing the design space for gradient index (GRIN) optics, in particular additive manufacturing technology. Control over index of refraction and dispersion in complex 3D profiles enables the development of truly 'freeform' gradient index optics. This talk will give an overview of some of the emerging manufacturing technologies and recent projects from our research group. It will also cover topics of interest to our group and design aspects that will benefit from freeform GRIN materials.

Biography:

Greg Schmidt received his PhD from The Institute of Optics, University of Rochester. His thesis focused on the modeling and design of bio-inspired compound lens arrays and fabricating polymer tapered gradient index lenses that mimic the gradient index (GRIN) lenses found nature. After graduating in 2009 he became a Research Engineer at The Institute of Optics and in 2019 became a research professor. His primary projects involve research in GRIN materials, including modeling, design, optimization, fabrication, and metrology of GRIN optics. Other significant research efforts have focused on lightfield optics, non-imaging design for illumination, and optics for high concentration solar thermal and photovoltaic systems.

Contact Information: greg.schmidt@rochester.edu

Damon Diehl
Technology Program Manager
NextCorps Luminate

Industry Presentation
9:20 – 9:40 AM

Title: "The Luminate Startup Accelerator: Foundation and Future"

Abstract:

Startups developing technologies rooted in optics, photonics, and imaging (OPI) face steep challenges. Optics equipment and components are expensive, it is difficult to find talent, and product development can be slow. These factors make investors wary of funding OPI-based companies because of the perceived high risk. However, OPI is integral to almost high-tech development. If the US does not remain dominant in the continuous advancement of OPI technologies, there is a domino effect of falling behind in every market that relies on OPI. The Luminate Startup Accelerator was launched in 2018 to address the threat of the Finger Lakes region of New York losing its place at the forefront of OPI product development. Luminate leverages the region's unique resources to support a startup's need for optical design, fabrication, and testing. The Luminate program also de-risks these startups as investments. Of the 40 companies that have graduated from Luminate over the past four years, only three have gone out of business. Furthermore, by de-risking the companies that complete the Luminate program, Luminate graduates have been highly successful at bringing in follow-on funding—As of December 2021, Luminate teams have, collectively, brought in over $90 million.

Biography:

Dr. Damon W. Diehl is the Technology Program Manager at the Luminate Startup Accelerator in Rochester, NY. Luminate is the largest startup accelerator in the world for optics, photonics, and imaging (OPI) technologies. At Luminate, Damon oversees integrating Luminate startups into the New York OPI community by either locating businesses here or contracting regional optics companies for optical design, manufacturing, and assembly. He also helps Luminate companies find and hire qualified talent. Since 2011, he has been a popular lecturer for SPIE, teaching an optics class for non-engineers and a workshop on grant-writing for early-career professions. In 2021, he published a book with SPIE, Grant Writing from the Ground Up, based on his grant-writing course.

Contact information: damon.diehl@nextcorps.org

Ph.D. Research Presentations

10:15-11 AM

Kaitlin Dunn

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

Title: "Angular light scattering for estimating organelle size distributions in single cells"

David Lippman

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

Title: "Freeform illumination using gradient-index optics"

Tianyi Yang

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

Title: "Freeform GRIN in rotationally variant optical system"

Nicholas Kochan

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

Title: "Method to directly convert reflective and refractive surfaces to gradient index functions with maintained ray behavior"

Saleem Iqbal
Ph.D. Candidate, Optics
The Institute of Optics | University of Rochester
UR SPIE Student Chapter President

Student Chapter update
1:15-1:30 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: siqbal3@ur.rochester.edu

Antony Georgiadis
Undergraduate, Optical Engineering (BS anticipated ’23)
The Institute of Optics | University of Rochester
Optica Student Chapter President

Student Chapter update
1:15-1:30 PM

Title: Optica Student Chapter Update

Biography:

Antony Georgiadis is currently an undergraduate junior at the University of Rochester. His interests include lens and system design, automation, and optics education. Antony is currently the President of the Optica Student Chapter at the University of Rochester, leading efforts to engage students in professional development opportunities, outreach in the community and social events. Antony will graduate in May 2023 with a Major in Optical Engineering.

Contact Information: ageorgi2@u.Rochester.edu

Will Renninger
Assistant Professor
The Institute of Optics | University of Rochester

Research Presentation
1:30 – 1:50 PM

Title: "Femtosecond optical pulse generation without the mode-locked laser"

Abstract:

Ultrashort pulses of light are essential for applications including in telecommunications, precision machining, and biomedicine. Ultrashort pulses are generated today using active laser cavities known as mode-locked lasers. However, while they have been very useful, mode-locked lasers are ultimately limited in their operation wavelength, pulse energy, and repetition rate by their need for an efficient gain medium. This gain limitation dramatically increases the cost of the sources required by many applications, including for nonlinear deep-tissue imaging. This talk will discuss the development of a promising alternative to mode-locked lasers, fiber Kerr resonators. Kerr resonators support femtosecond optical pulses in passive cavities, without the need for the limiting gain medium. This talk will survey recent results from our lab including cavities that can support very high energies and measurements of the shortest pulses to date from these simple passive systems. The talk will conclude with a discussion of some exciting future directions for Kerr resonator technology.

Biography:

William Renninger is an Assistant Professor at the Institute of Optics and the Department of Physics and Astronomy at the University of Rochester. He received his BS and PhD degrees in Applied Physics from Cornell University before his postdoctoral research in the Department of Applied Physics at Yale University. Professor Renninger' s research interest is in experimental light-matter interactions. His group focuses on ultrafast nonlinear optics and pulsed lasers for applications including imaging deep into the brain. They also investigate coherent interactions between photons and phonons for applications in quantum computing, high-speed telecommunications, and dark matter detection. He is a member of Optica and SPIE, has co-authored a book chapter, >40 papers, >70 conference proceedings, seven patents, and is a recent recipient of the NSF CAREER award.

Contact Information: william.renninger@rochester.edu

Juniyali Nauriyal
Ph.D. Candidate, Electronics and Communications Eng.
Univeristy of Rochester
Co-founder and CEO | Photonect Interconnect Solutions

Research Presentation
1:50-2:15 PM

Title: "Optical Fusion Splicing For Integrated Photonics Chips"

Abstract:

With the increasing need for higher data rates of the order of a few terabytes to zettabytes, data centers and optical transceivers companies are now migrating to integrated photonics to keep up with the data rates. However, packaging of integrated photonic devices to optical fibers remains a slow and expensive process. To keep up with the highly data-driven communication systems and with the advent of co-packaged optics, a low-cost and low-loss packaging technique that can be scaled to high volume manufacturing for photonic integrated circuits is needed. We present a packaging technique that uses fusion splicing to connect optical fibers to integrated photonics chip.

Biography:

Juniyali Nauriyal is a co-founder of Photonect Interconnect Solutions Inc and a Ph.D. student at the University of Rochester. She is working on packaging integrated photonic devices by providing a high-performance and cost-effective solution. She is a Ph.D. student in the Electrical engineering Department at the University of Rochester. She completed her B.E. degree from Mumbai University in India in 2016 and got her MS degree from the Institute of Optics at the University of Rochester in 2018. She was awarded the Corning Women in Optical Communications Scholarship in 2022, Harvey M. Pollicove Memorial Scholarship in 2018 by Optica, and Best ISA Student Award in 2016 by ISA-Maharashtra (International Society of Automation).

Contact information: jnauriya@ur.rochester.edu

Jaime Cardenas
Assistant Professor
The Institute of Optics | University of Rochester

Research Presentation
1:50-2:15 PM

Title: "Optical Fusion Splicing For Integrated Photonics Chips"

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Biography:

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MS Showcase

Adnan Al-Abbar

Education Highlights

- (KU) B.Sc. Physics, minor in math.
- (UR) M.Sc. Optics (current).

Work Experience

- Research on Nuclear Physics (KU)
- Research on Environmental Science (KISR)

Objectives

- Work in medical physics, or research in optics and optical physics for the Summer of 2022.

Haolin Liao

Education Highlights

- 1st year M.S. student in Optics
  Selected courses: Geometrical Optics, Lens Design, Radiation and Detection
- Research: Real-time Peripheral Nerve Imaging
- Undergraduate major: Physics

Work Experience

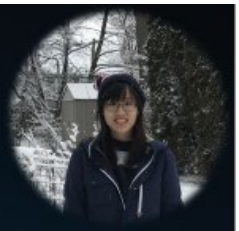
- Previous research topics:
Full-color E-ink fabrication, Metalens design
- Skilled in: MatLab, Labview, CodeV

Objectives

.-Ph.D position

- Summer position

Jing-Yi Wang



MS in Optics, U of Rochester
- ✓ Design project: Airborne Camera for Cross-checking Satellite GPS image for Hydrology

Coursework: Lens Design, Geometric optics, Polarization, Optics Laboratory

MS in Photonics, NCTU
- ✓ Thesis: A Study of Optical Phases in Polymer-Dispersed Liquid Crystals

Garmin Corporation
Advanced Display and Optical Engineer II
- ✓ Display optical characterization methodologies
- ✓ Touch panel pattern design
- ✓ Project management

NCTU TA (MATLAB, Mathematica)
The Language of Technical Computing

2023 full time job (expected graduation in Dec 2022) as **Optical engineer**

Montgomery Whalen

MS in Optics, University of Rochester
- Optics lab, Machine Learning, Computational Imaging, Lasers, Lenses, Wave Optics, Precision Instrument Design

MS in Mathematics, Western Washington University
- Numerical Analysis, Fourier Analysis, Statistics, Mathematical Modeling

BS Math, BA Econ, CS minor, WWU
- Databases, Data Structures

Western Washington University
- Graduate Teacher
  - Gave lectures to classes of over 30 students in pre-calculus, calculus, and linear algebra
  - Developed soft skills and assisted program in converting classes to online format

❑ Experience with MATLAB, Mathematica, R, Java, Python, SQL

➢ Seeking Optical Engineering Co-op position for 2022

Poster Competition

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

Nicholas Achuthan – Optics BS

Title: Efficient on-chip generation of hyperentangled photons at telecom wavelengths
Abstract: Entangled quantum states allow many quantum communication protocols, such as superdense coding and quantum teleportation, to exceed classical computation limits. Recently, integrated photonics has proven to be a powerful platform for quantum computing using the photon as the qubit. In quantum photonics, Spontaneous Parametric Down Conversion (SPDC) is a frequently used method to generate polarization-entangled photons and can be optimized on-chip via nonlinear waveguides. Here we propose an integrated approach to efficiently generating entangled photons at telecom wavelengths through SPDC in a periodically-poled lithium niobate waveguide. The chip-scale platform additionally allows for manipulation of a photon's transverse spatial mode, which can be combined with other degrees of freedom to generate hyperentangled photon states, further increasing the information capacity of a single photon.

Xue Dong – Physics PhD

Title: 120-fs single-pulse generation from stretched-pulse fiber Kerr resonators
Abstract: Ultrashort pulses are important in many application areas, including material processing, imaging, and eye surgery. In contrast to traditional mode-locked lasers, Kerr resonators are an emerging alternative with desirable wavelength and flexible repetition rate for generating ultrashort pulses. However, generating a single soliton with a femtosecond-regime pulse duration in fiber Kerr resonators remains an outstanding challenge. Through this study, we observe stable pulses as short as 120 fs, which is the shortest duration measured to date from a fiber Kerr resonator. In addition, single soliton generation based on soliton trapping is demonstrated with a pulsed drive source despite large intracavity soliton breathing. The performance and control of Kerr solitons demonstrated in this report will be valuable for simple and robust wavelength versatile femtosecond pulse generation.

Kaitlin Dunn – Optics PhD

Title: Modifying the refractive index of a cell's immersion medium isolates organelles' angular scattering from whole-cell contributions
Abstract: Angularly-resolved light scattering is useful for computing organelle size metrics of a cell due to its sensitivity to scatterer size and refractive index contrast.

Unfortunately, the cell itself acts as a larger scatterer and contributes its own angular signature. For an adherent cell on a coverslip immersed in standard media with a refractive index close to that of water, we have found that the cell:media refractive index contrast can contribute significant scattering at angular deflections below twenty degrees. This whole-cell scattering, highly dependent on the cell's shape and size, is challenging to distinguish from the desired organelle scattering signal. This degrades the accuracy with which organelle size information can be extracted from the angular scattering signal. To address the whole-cell contribution, we manipulate the refractive index of the immersion medium by mixing it with a water-soluble, biocompatible, high-refractive-index liquid. By minimizing the refractive index contrast between the cytoplasm and modified medium, this approach physically reduces the amount of whole-cell scattering. We demonstrate this technique on fixed and live cells, using a Fourier phase microscope to obtain the complex field of the sample and using Fourier transform light scattering to compute the angular scattering. Results show significant reduction of the whole-cell contribution, indicating the potential of this method for improving the estimates of organelle size distributions in single cells.

Yi-Ting Feng – Optics PhD

Title: Simulation and modeling for 3D localization and 3D orientation for single-emitter microscopy

Abstract: Super-resolution imaging based on single-molecule localization achieves high resolution on the order of 10–20 nm with high precision. However, the orientation and position of a single molecule are intrinsically coupled in microscopy imaging. In the technique, CHIDO (Coordinate and Height super-resolution Imaging with Dithering and Orientation), polarization control is used to manipulate the phase distribution in the Fourier plane to even decouple the 3D spatial position, 3D orientation, and wobbling or dithering angle of single molecules. In this research, we present the CHITO technique and further extend such technique by considering a fluorescence mark as a spherical bead for calibration.

Tyler Godat – Optics PhD

Title: In vivo calcium imaging reveals L/M opponent ganglion cells consistent with single cone receptive fields at the macaque foveal center

Abstract: The fovea is specialized for high spatial resolution and color vision, but there is a paucity of recordings that elucidate how retinal ganglion cells (RGCs) at the very center of the fovea facilitate this specialization. Here, we optically record responses using adaptive optics scanning light ophthalmoscopy in three macaques to spatial and chromatic stimuli using calcium indicators in the living eye to characterize the receptive field (RF)

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.

Xiaotong He – Optics PhD

Title: Electrically induced adiabatic wavelength conversion in an integrated lithium niobite ring resonator

Abstract: Changing the frequency of light outside the laser cavity is typically done by a nonlinear process such as three or four wave mixing. However, integrating a system with a high-power optical pump onto a photonic chip is challenging. To achieve on-chip optical frequency conversion, we introduce a method of electrically tuning a ring resonator to induce adiabatic wavelength conversion. With this technique, we can dynamically control light in a cavity within the photon lifetime by tuning the refractive index of ring resonators electrically.

Tyler Howard – Optics PhD

Title: Polarization Dependence of Engineered Scattering Elements in Photonic Integrated Circuits

Abstract: National foundries are providing a readily accessible avenue for photonic integrated circuit (PIC) technology, but prompt, efficient and reliable quantitative measurements of the waveguide performance within a PIC (e.g., polarization and loss) in the packaging and testing stage is an important challenge that must still be overcome. Numerical modelling of engineered scattering elements has demonstrated a significant polarization dependence to the input mode. This work experimentally verified the polarization response of engineered scattering elements placed in PICs fabricated through the AIM Photonics Foundry.

Arjun Iyer – Optics PhD

Title: Frequency Tunable Bulk Optomechanical Systems

Abstract: Micro and nano-optomechanical systems are limited in their range of accessible phonon frequencies and corresponding lifetimes. As a consequence, frequency-selective applications are restricted, and application-desirable interaction strengths and coherence are limited. Brillouin-like optomechanical interactions can access ultra-long-lived phonons in bulk crystalline acoustic resonators with the potential for incredible frequency versatility if the wavevectors of the participating optical beams can be appropriately engineered. Here, we demonstrate phonon frequency tuning in bulk optomechanical systems by nearly 2 orders magnitude, from hundreds of MHz to tens of GHz.

Sushant Kumar – Optics PhD

Title: Chirped Pulse Generation On-Chip

Abstract: Coherent optical pulses are of vital importance and have potential applications in fields like communications, metrology, LiDAR, time keeping and even surgery. While solid-state and fibre based mode-locked lasers are the benchmark for high power, short duration pulses; they tend to be extremely bulky and expensive. To scale the technology for en masse applications, chip-scale coherent sources are needed. While such sources have been demonstrated on multiple platforms, they lack the pulse power and design flexibility to be of use in many of the above applications. This work aims to solve the issue via generation of coherent chirped pulses on chip.

Benjamin Moon – Optics PhD

Title: Alignment and validation of an AOSLO for imaging the human cone mosaic in the central fovea

Abstract: Imaging the human foveal cone mosaic in vivo with cellular resolution provides rich opportunities for studying foveal anatomy and its impact on visual perception and eye movements. Achieving cellular resolution at the center of the fovea—where cones are smallest and most densely packed—requires an optimized and well-aligned adaptive optics scanning laser ophthalmoscope (AOSLO). An active alignment strategy was implemented using a portable Shack-Hartmann wavefront sensor to measure the wavefront aberrations after each relay telescope in the AOSLO. This alignment process enabled a diffraction-limited scanning and light delivery system to be realized. Additional system testing was conducted to calibrate the scanning field of view, correct for the distortions introduced by the sinusoidal motion of the resonant scanner, and measure the system resolution with a three-bar resolution target for each of the three spectral imaging channels in the system. In vivo human retinal images were collected with the system, demonstrating that the smallest cones at the center of the fovea are resolved. These high-resolution images will be used in subsequent analyses to investigate the relationship between foveal cone density, visual acuity, and fixational eye movements in humans with normal vision.

Jesus Sanchez Juarez – Elec. & Comp. Engg. PhD

Title: Automated System for Detection of 2D Materials Using Digital Image Processing and Deep Learning

Abstract: This research shows the development of intelligent algorithms to detect monolayers of WSe2, MoS2 and h-BN autonomously using digital image processing and deep learning with high accuracy rate of 99.9%, avoiding human interaction and

any additional characterization tests such as photoluminescence or Raman spectroscopy, with a total processing time of 9 min.

Yichen Shen – Optics BS

Title: Measuring Second-Order Correlation with Michelson Interferometer
Abstract: The HBT interferometer is a typical way to measure the second-order intensity correlation in statistical optics. However, the response time of photodetectors gives a fundamental limit on the timescale of the measurements. We utilized the two-photon absorption in a semiconductor photomultiplier tube with a Michelson interferometer to study the second-order correlation function of optical sources.

Meiting Song – Optics PhD

Title: Enhanced on-chip phase measurement by weak value amplification
Abstract: Weak value amplification enhances signal without amplifying noises such as shot noise and 1/f noise. Achieving weak value amplification with integrated photonics devices adds compatibility and stability to ultrasensitive measurements. We demonstrated 9dB signal enhancement with on-chip device using inverse weak value amplification over a standard Mach-Zehnder interferometer with equal detected power.

Mike Taylor – Optics PhD

Title: Resolution of Gauge Ambiguities in Cavity QED
Abstract: Coupling molecules to the quantized radiation field inside an optical cavity creates a set of new photon-matter hybrid excitations, so-called polaritons. The rich dynamic interplay among these electronic, photonic, and nuclear degrees of freedom (DOF) has enabled a new paradigm for achieving unique chemical reactivities. The non-relativistic quantum electrodynamics (QED) Hamiltonian that describes such quantum light-matter interactions should obey the gauge principle, i.e. having gauge invariant observables. While the QED Hamiltonian under both the Coulomb gauge and the dipole/length gauge indeed obeys this principle, these Hamiltonians under a finite electronic state truncation are known to give different results for physical observables, which is commonly referred to as the gauge ambiguity. Similarly, the choice of gauge for a truncation of the photonic modes leads to a potential ambiguity, as one arrives at two different dipole gauge Hamiltonians when performing mode truncation before or after performing the Power-Zienau-Wooley (PZW) gauge transformation. We provide a theoretical framework to address these ambiguities and demonstrate how to accurately perform electronic and photonic mode truncations in both the Coulomb and dipole gauges. We propose a new theoretical framework to consider truncations in light-matter interaction Hamiltonians by performing the truncation further upstream and using a properly confined PZW operator. By following this procedure, any gauge ambiguities caused by matter or photonic mode truncation are resolved

Rongze Xu – Optics MS

Title: Freeform Gradient Index Prescribed Illuminators

Abstract: The increasing development of freeform optics has inspired several design methods to generate the prescribed irradiance profile. David Lippman and Greg Schmidt proposed a design method of applying gradient index (GRIN) optics to illumination optics[1]. Nanovox, LLC, as a GRIN lens manufacturer, has manufactured designed samples for this project through 3D printing technology. The fabricated samples were tested with an approximate point LED to obtain the illumination irradiance distribution, imaging quality, and comparison with the simulation results. Grayscale mode designs are investigated and presented to show the F-GRIN lighting systems' development prospects.

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 (Si3N4) is a low-loss, CMOS-compatible material that has revolutionized many fields including integrated optics and nonlinear optics. So far, however, its application in limited because it lacks an electro-optic response. We present an approach to build permanent second-order nonlinearity in Si3N4 by electrically aligning the Si-N bonds and demonstrate non-trivial electro-optic response up to 15GHz modulation frequency.

Professional Organizations: Student Chapters

SPIE

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: Kaitlin Dunn
Vice President: Saleem Iqbal
Secretary: Ben Moon
Treasurer: Wooyoun Kim
Web Administrator: Janet Tang
Communications Officer: Rob Holcomb
Outreach Chair: Tyler Howard
Faculty Advisor: Greg Schmidt
Senior Faculty Advisor: Jannick Rolland

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

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:

President: Antony Georgiadis
Professional Development Chair: Dwight Fairchild
Social Chair: Icel Sukovaty
Professional Development: Natalie Fullerman
Outreach Chair: Kendall Smith
Secretary: Lukas Ladas
Business Manager: Gabriel Medina

Email information:

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.

Optics Summer Short Course Series, June 2022

This summer we will host the 61st annual Summer Short-Course Series. Course dates are set for June 6th - June 22rd, 2022. All courses will be instructed remotely.
Registration is now open, please register by clicking here.

Course Schedule:

Fundamental Concepts, June 6-15
Covering lenses, aberrations, principles of diffraction, optical systems, polarization, birefringence and crystal optics, and radiometry and detection.

Optical Thin Film Coating Technology, June 6-15
Covers all aspects of optical interference devices including thin-film design, digital design methods, and coating and characterization.

Integrated Photonics Circuits, June 6-17
Targeted for students, researchers, and engineers in industry, who want to learn the fundamental aspects of integrated photonics circuits.

Applied Concepts, June 8 - 14
Colorimetry and vision, wave guide photonics, and more.

Optical System Design, June 13-17
Introduces participants to both fundamental and advanced concepts in optical system design by integrating classroom lectures with software training labs. The course can be taken as a full week course or as one of two three-day course options depending on interest/skill level. *Introduction to Optical System Design* covers first order layout, image quality evaluation, aberration theory, optimization, and refractive/reflective design forms. *Advanced topics in optical system design* begins with refractive/reflective design forms and then covers advanced optimization techniques, zoom lenses, aspheres, stray light analysis, tolerancing, and illumination design.

Modern Optical Engineering, June 13-17
Covering optical testing and instrumentation, optical manufacturing, optical thin film coatings, diffractive optics, and glass in modern optics.

Introduction to Computational Imaging and Information Essentials, June 13-17
Introduces computational imaging, a modern paradigm in imaging in which the burden of image formation is no longer borne solely by optical physics.

Ultrafast Optics and Petawatt Laser Systems, June 22-24
This course serves as an introduction to ultrafast laser systems with an emphasis on chirped pulse amplification and the generation of ultrahigh peak powers and irradiances.

IA Members

Industrial Associate members are listed alphabetically within membership levels: Strategic, Society & Trade Associations, Select, Standard and Associate.

Strategic IA Members

ASML
www.asml.com

Corning Incorporated
www.corning.com

Danbury Mission Technologies
(formerly Collins Aerospace)
www.dmtllc.org

Edmund Optics
https://www.edmundoptics.com/

L3Harris Technologies (NY)
www.l3harris.com

MKS Instruments
www.mksinst.com

OptiPro Systems, Inc.
www.optipro.com/index.html

Synopsys
www.synopsys.com

Zemax
www.zemax.com

Zygo | Ametek
www.zygo.com

Society, Trade, & Academic Association IA Members

Monroe Community College STATE UNIVERSITY OF NEW YORK	**Monroe Community College** ***www.monroecc.edu***
NEW YORK PHOTONICS PHOTONICS ROCHESTER	**New York Photonics** ***www.newyorkphotonics.org*** ***www.rrpc-ny.org***
nextcorps LUMINATE	**NextCorps | Luminate** ***www.nextcorps.org*** ***www.luminate.org***
OPTICA Advancing Optics and Photonics Worldwide Formerly OSA	**The Optical Society** ***https://www.optica.org/en-us/home/***
SPIE.	**The International Society for Optics and Photonics** ***www.spie.org***

Select IA Members

AFRL THE AIR FORCE RESEARCH LABORATORY LEAD | DISCOVER | DEVELOP | DELIVER	**Air Force Research Lab (AFRL)** *www.wpafb.af.mil/afrl/*
amazon Lab126	**Amazon Lab 126** https://amazon.jobs/en/teams/lab126/
	Apple *www.apple.com*
AOM Arizona Optical Metrology	**Arizona Optical Metrology** https://cghnulls.com/
Google	**Google** https://arvr.google.com/ar/
II-VI AEROSPACE & DEFENSE	**II-VI Inc.** *www.ii-vi.com*
LUMINAR	***Luminar Technologies*** *https://www.luminartech.com/*
	Lawrence Livermore National Lab *www.llnl.gov*
LOCKHEED MARTIN	**Lockheed Martin** ***(Missile & Fire Control and Space Systems)*** *www.lockheedmartin.com*

MIT Lincoln Laboratory
https://www.ll.mit.edu/

Microsoft
www.microsoft.com

Raytheon
www.raytheon.com

Snap Inc.
www.snap.com

Sunny Optical Technology Group Co., Ltd.
www.sunnyoptical.com

Viavi Solutions
https://www.viavisolutions.com/en-us

Standard IA Members

Avo Photonics	**Avo Photonics** https://www.avophotonics.com/
REALITY LABS RESEARCH	**Facebook Reality Labs, Meta** www.facebook.com/careers/areas-of-work/facebookrealitylabs
JANOS TECHNOLOGY	**JANOS Technology** www.janostech.com
JENOPTIK	**JENOPTIK Optical Systems** www.jenoptik-inc.com
NAVITAR®	**Navitar** www.navitar.com
Optikos® The Optical Engineering Experts®	**Optikos** www.optikos.com
OPTIMAX®	**OPTIMAX Systems, Inc.** www.optimaxsl.com
QVI Quality Vision International Precision for People®	**Quality Vision International, Inc.** www.qvii.com
SONY®	**SONY Electronics Inc.** www.sony.com

Associate IA Members

	**Bristol Instruments, Incorporated** ***www.bristol-inst.com***
	**Gray Optics** ***www.grayoptics.com***
	**OptoSigma Corporation** ***www.america.optosigma.com/***
	**Plymouth Grating Laboratory** ***www.plymouthgrating.com***
	**Spica Technologies** ***www.toptica.com***
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